REPUBLIC OF NAMIBIA

MINISTRY OF WORKS, TRANSPORT AND COMMUNICATION

DEPARTMENT OF TRANSPORT

FEASIBILITY STUDY ON THE NORTHERN RAILWAY EXTENSION FOR NAMIBIA

FINAL REPORT

VOLUME 1

MAIN REPORT

MAY 1999

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Africon Namibia

This report was funded by the US Trade and Development Agency (TDA), an export promotion agency of the United States Government. The opinions, findings, conclusion, or recommendations expressed in this document are those of the author(s) and do not necessarily represent the official position of TDA.

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FEASIBILITY STUDY ON THE NORTHERN RAILWAY EXTENSION FOR NAMIBIA

FINAL REPORT

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1. INTRODUCTION

1.1 BACKGROUND

Namibia is a large country with a small population. Total land area is 824,269 km² with a population of approximately 1,800,000. Only about 10% of the land is arable with two major deserts occupying large parts of the west and southeast regions of the country. Most of the arable land, as well as most of the population, is in the north. Over 60% of the total population lives in the seven northern regions with over 40% in the four regions, Oshikoto, Ohangwena, Oshana and Omusati collectively referred to as the Four O Regions, which the proposed Northern Railway Extension would serve.

Gross Domestic Product per capita for all of Namibia is about US$ 1,250 which is relatively high for a developing country. However, there are large discrepancies between regions and population groups and the median income in the Four O Regions is only about US$ 850.

The area through which the proposed railway would be built is characterized by commercial farms south of Oshivelo and communal land to the north. There has been very little commercial development except in the vicinity of Ondangwa and Oshakati. The movement of consumer goods into Angola and a new Export Processing Zone (EPZ) has stimulated some development at Oshikango as well.

This dependence on subsistence farming and basic commerce and trade may be changing. Development of industrial activity has started recently with, for example, the opening of a paint factory in Oshakati and a steel fabricating plant in Ondangwa.

A priority of the Government of the Republic of Namibia is to provide the necessary infrastructure to expand the economy of the northern regions and improve the living standards of the 60% of the national population who live there. A logical means of doing this would be to improve the transportation network and construction of the proposed rail line would be a major step. The new railway would be approximately 300 km in length extending from the present northern terminus at Tsumeb to Ondangwa, Oshakati and Oshikango.

An additional Government goal is to strengthen ties, by means of improved transportation networks, with neighboring countries. The extension of the proposed northern line to the Angolan border at Oshikango would facilitate eventual connections to the Angolan railway system (CFM) near Chamutete. Besides providing better transportation of commodities and passengers, this rail line would allow traffic to and from Angola to be routed through Walvis Bay which is the most efficiently operated port in southern Africa.

There are three potential international rail development corridors under study of which the Angolan route is one. The three are shown in Figure 1.1.

There are indirect economic benefits inherent in a rail line extension. These include diversion of traffic from congested roads, more freight and passengers handled with less air pollution, energy savings and lower total vehicle operating costs.

1.2 STUDY OBJECTIVES

The basic objectives of this study as specified in the Terms of Reference (see Appendix 1.1) are as follows:

- Identify the best route for a railway connecting Tsumeb with Ondangwa, Oshakati and Oshikango.
- Prepare preliminary plans and profiles of the proposed line.

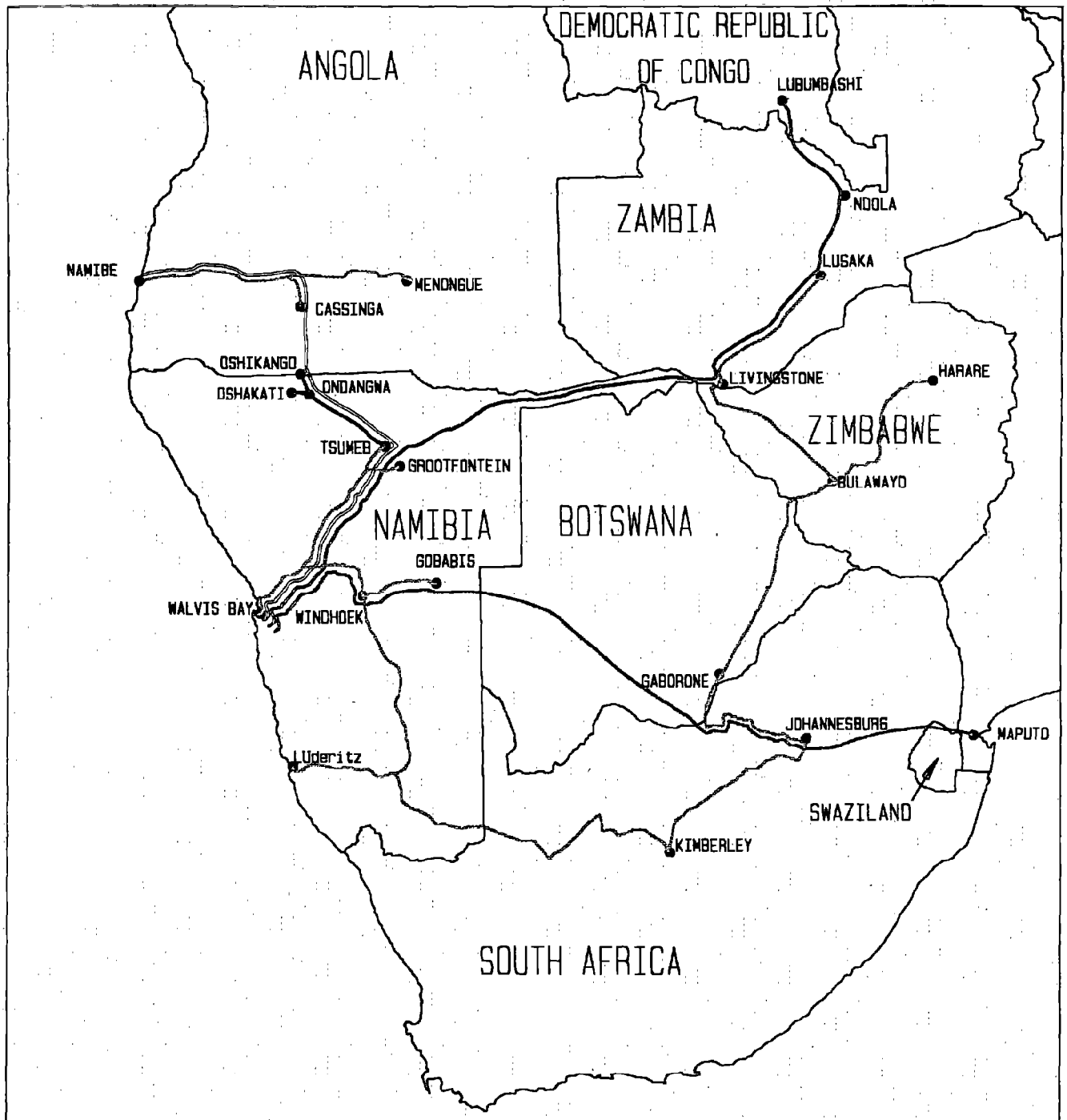


FIGURE 1.1
POTENTIAL INTERNATIONAL CORRIDORS
CONNECTING NAMIBIA
WITH REGIONAL COUNTRIES

EXISTING RAILWAYS
(ONLY MAIN ROUTES SHOWN)
PROPOSED NORTHERN EXTENSION
DEVELOPMENT CORRIDORS
1) WALVIS BAY-OSHIKANGO-NAMIBE
2) WALVIS BAY-BOTSWANA-GAUTENG-MAPUTO
3) WALVIS BAY-CAPRIVI-NDOLA-LUBUMBASHI

Prepare a preliminary design including rolling stock and support facility requirements and cost estimates for the proposed line.

- Estimate potential freight and passenger traffic and revenue.
- Develop an operating plan and associated costs.
- Determine operational requirements and capabilities of the proposed line, as well as connecting NamRail routes that would be affected by increased traffic flow.
- Examine financial and economic aspects of the proposed line including revenue and operating expense, capital costs and return on investment and perform appropriate sensitivity analysis.
- Identify social, non-financial and other secondary impacts on the region and nationally.
- Examine social and environmental issues and identify potential impacts and suggest mitigation measures.
- Recommend a proposed financing and construction scheme for the Northern Railway Extension.
- Make a preliminary analysis of the potential for increased international traffic with Angola.

1.3 METHODOLOGY

A map of the study area is shown in Figure 1.2.

In order to perform the study in the most systematic and efficient manner, the work was subdivided along functional lines into eight major categories:

- Traffic Demand Forecast
- Operations
- Social and Environmental Issues
- Engineering
- Capital Costs
- Operating and Maintenance Expense
- Financial and Economic Evaluation
- Implementation Phasing and Financial Plan

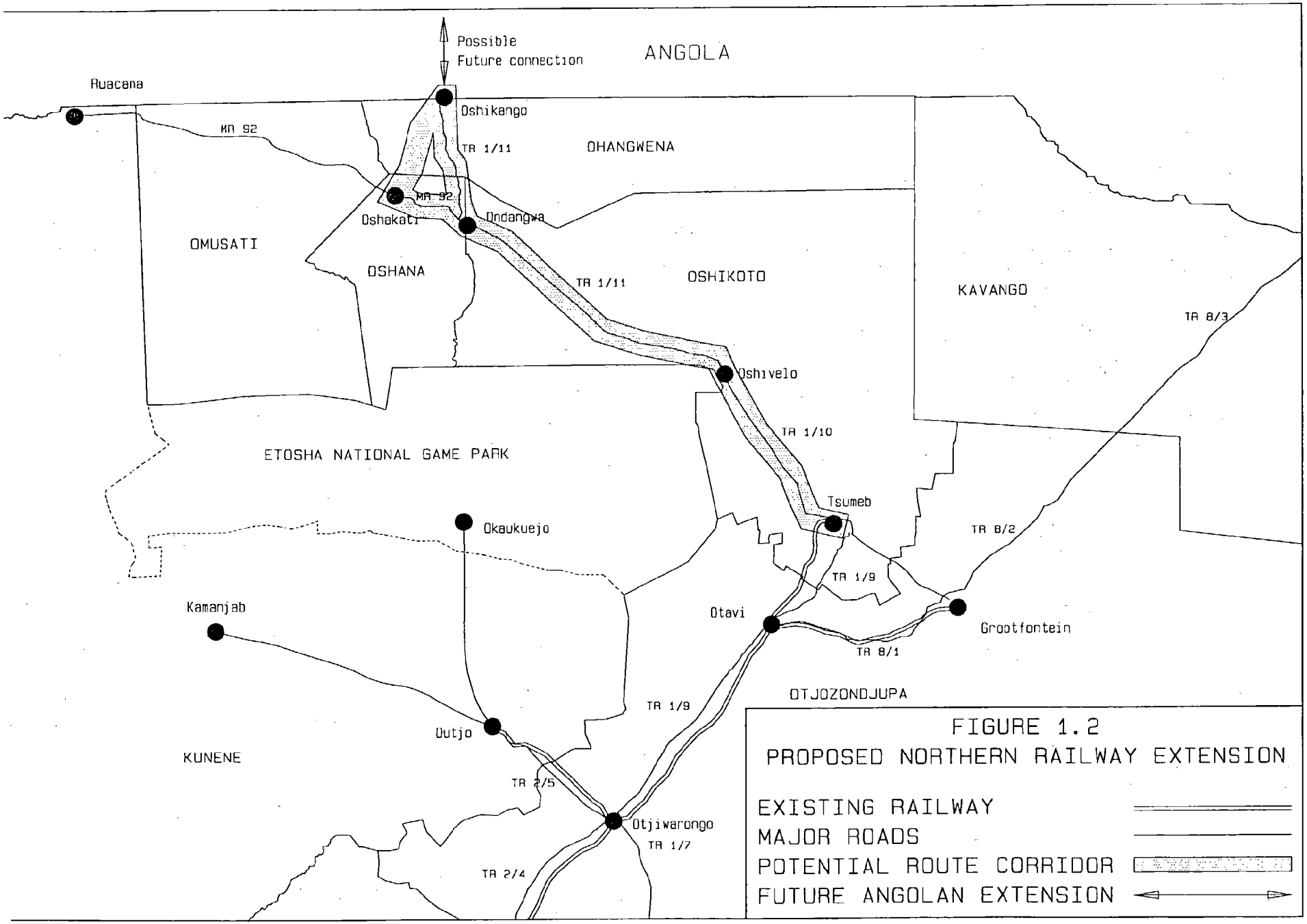
An expert group leader assisted by technicians and specialists conducted each phase of the study. All activities were directed and co-ordinated by the Project Manager who was responsible for overall conduct of the project and liaison with the Ministry of Works, Transport and Communication.

Unless specifically noted, the Consultant provided all data used and made all of the calculations used in the tabulations shown in the report. References utilized are shown in Appendix 1.2.

1.4 WORK PLAN

There were two primary categories of data involved:

- That relating to the railway.
- That relating to the area and Namibian economy in general.


Possible
Future connection
ANGOLA
Ruacana
MR 92
Oshikango
TR 1/11
OHANGWENA
MR 92
Oshakati
Ondangwa
OMUSATI
OSHANA
TR 1/11
OSHIKOTO
KAVANGO
TR 8/3
Oshivelo
TR 1/10
ETOSHA NATIONAL GAME PARK
Tsumeb
TR 8/2
Okaukuejo
TR 1/9
Kamanjab
Otavi
Grootfontein
TR 8/1
OTJOZONDJUPA
TR 1/9
Outjo
KUNENE
TR 2/5
Otjiwarongo
TR 1/7
TR 2/4
FIGURE 1.2
PROPOSED NORTHERN RAILWAY EXTENSION
EXISTING RAILWAY
MAJOR ROADS
POTENTIAL ROUTE CORRIDOR
FUTURE ANGOLAN EXTENSION

At the start of the project, staff members determined the information needed to fulfill their specialized assignments, reviewed all relevant reports and previous studies and assembled the additional mapping and other data required.

In addition, staff members made field inspections to familiarize themselves with the characteristics and terrain of the study area, meet with local officials and identify conditions that could create development opportunities or might cause problems. In addition, an aerial reconnaissance of the entire route was made.

Specific tasks undertaken in each of the functional areas, included the following:

1.4.1 Traffic Demand Forecast

- Determine present freight and passenger traffic in the study corridor.
- Estimate traffic that could be diverted to rail under different sets of assumptions.

1.4.2 Operations

- Analyze characteristics of the proposed line and the connecting NamRail routes.
- Determine the capacity in terms of wagonloads and trains required to transport the anticipated traffic over the new line and connecting routes.
- Develop an appropriate passenger and freight service plan.
- Determine track capacity, communication system requirements and support facilities needed.
- Identify rolling stock requirements.

1.4.3 Social and Environmental Issues

- Analyze development characteristics of the area.
- Determine land use patterns
- Identify potential impacts caused by construction and operation of the line.
- Suggest procedures to mitigate any adverse environmental factors or other undesirable economic or social issues.
- Outline the detailed environmental assessment that must be conducted.

1.4.4 Engineering

- Confirm the design standards to be used.
- Identify possible routes and select the best alignment based on track geometry, least possible intrusion on sensitive areas and geotechnical considerations.
- Prepare preliminary plans and profiles for the selected route.
- Prepare preliminary layouts and configurations of stations and other facilities.

1.4.5 Capital Costs

- Estimate infrastructure costs.
- Estimate rolling stock costs.
- Estimate costs associated with construction.
- Summarize capital costs.

1.4.6 Operating and Maintenance Expense

- Estimate train operating expense.
- Estimate station operating expense.
- Estimate infrastructure maintenance expense.

1.4.7 Financial and Economic Evaluation

- Estimate revenues.
- Perform an economic and financial analysis.
- Make appropriate sensitivity tests.
- Identify non-financial benefits that would result from construction of the rail line.

1.4.8 Implementation Phasing and Financial Plan

- Prepare a construction schedule.
- Develop a construction program maximizing labour based methods.
- Consider financing options

1.5 PROJECT SCHEDULE AND DELIVERABLES

Activity on the project started November 1, 1998. The Inception Report was submitted on December 1, 1998. The Draft Final Report was submitted in April, 1999 and a presentation made to the MWTC. During the course of the study Monthly Progress Reports were also submitted. This Final Report summarizes the data assembled and analyzed, and the conclusions reached regarding the desirability and feasibility of the proposed Northern Railway Extension.

1.6 REPORT ORGANIZATION

The Final Report consists of four volumes:

Executive Summary

Volume 1 - Main Report

Volume 2 - Maps and Drawings

Volume 3 - Appendices

This Main Report (Volume 1) includes 10 sections, which are:

Section 1. Introduction

This section summarizes the background of the project and the study methodology, the organization of the report, and a baseline assessment of NamRail.

Section 2. Traffic Demand Forecast

Section 2 explains the assumptions used and how the passenger and freight traffic forecasts were developed.

Section 3. Operations

Capacity of the project line as well as connecting routes, description of operations on connecting routes, proposed passenger and freight service plans and track and facility requirements are discussed in Section 3.

Section 4. Environmental and Social Issues

Section 4 summarizes the environmental and social issues identified and suggested impact mitigation measures.

Section 5. Engineering

Section 5 explains the route selection process and how the line was located, how design standards were determined, describes terrain in the corridor and details proposed construction methods, quantities and costs.

Section 6. Capital Cost Estimates

In this section the capital costs for the three phases of construction are summarized.

Section 7. Operating and Maintenance Expense

This section explains how the operating and maintenance expenses associated with the new line were developed and tabulates the results.

Section 8. Financial and Economic Evaluation

This section discusses all financial aspects of the project including capital costs and operating expense, revenue estimation, financial and economic analyses and concludes with an overall evaluation in financial and economic terms.

Section 9. Implementation Phasing and Financial Plan

Section 9 sets forth a proposed construction schedule and discusses possible funding schemes.

Section 10. Conclusions and Recommendations

As the title of this section indicates, key findings of the report are summarized, overall viability discussed and recommendations made as to whether the project should be progressed and under what circumstances.

1.7 BASELINE ASSESSMENT OF NAMRAIL

The railway system operated by NamRail includes 2,382 route kilometers of trackage built to 1,065 mm gauge. The heaviest traffic routes connect Nakop on the South African border with Windhoek, Windhoek with Kranzberg, Swakopmund and Walvis Bay and Kranzberg with Tsumeb. Secondary lines extend from Seeheim to Lüderitz, Windhoek to Gobabis, Otjiwarongo to Outjo and Otavi to Grootfontein. The various routes were constructed between 1897 when the line between Swakopmund and Rössing was started and 1930 when the Windhoek-Gobabis line was completed. A map of the entire system is shown in Figure 1.3 and details of the physical plant shown in Appendix 1.3.

The railway is built to relatively light standards with allowable main line axle loads of 16-20 tons and restrictions of 11.5-15 tons on the secondary routes. This, however, is not inappropriate considering the volume of traffic handled. The main line is laid with 30-57 kg/m rail on steel and concrete sleepers and a ballasted roadbed. Secondary lines have 22-30 kg/m rail on mostly steel sleepers with short sections of wood sleepers, and generally no ballast. Upgrading is being done on main routes primarily with reusable 48 and 57 kg/m continuously welded rail (CWR) on concrete sleepers with Pandrol and Fist fastenings.

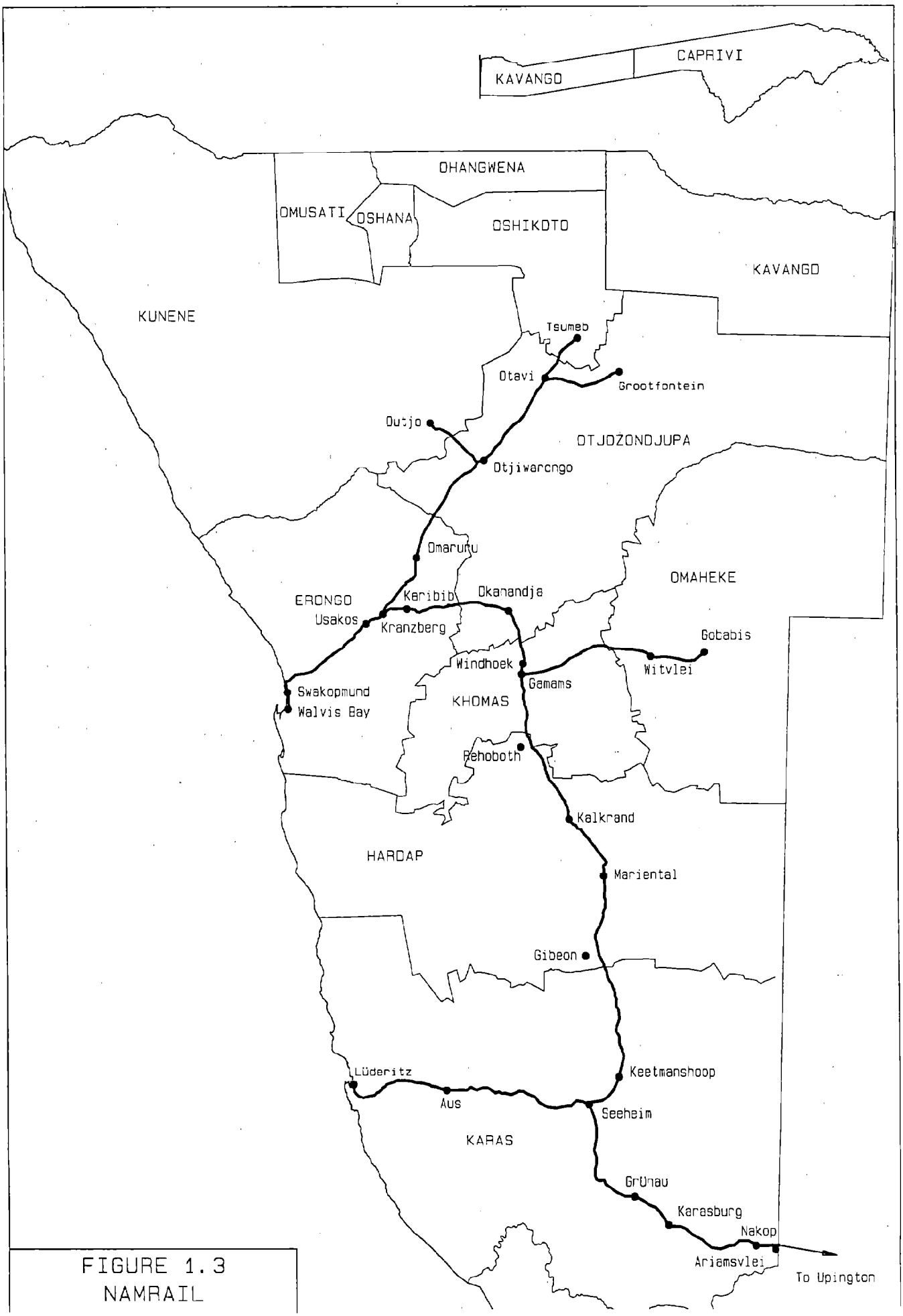


FIGURE 1.3
NAMRAIL

Organizationally NamRail is a subsidiary unit of TransNamib Limited, (TNL), which in turn is a State owned operational entity under the jurisdiction of the Minister of Works, Transport and Communication (MWTC). MWTC, in fact, retains ownership of permanent way and other fixed facilities although NamRail is responsible for maintenance. NamRail is divided into four regions plus a freight operations group in the RSA with total employment of about 2 400.

There are some reorganization programs affecting the transport sector now underway, but generally Government policy is moving toward an environment where road and rail will assume the full costs of doing business and compete on an equitable basis.

Recently enacted legislation provides that the Government will own the main track structure and NamRail will be the owner of the underlying property, all trackage except the main track, all structures and facilities and rolling stock. NamRail will, however, be responsible for all maintenance including that of main tracks.

A concept under consideration is the possibility of privatization of some railway operations or functions by concessionaires. This could, in particular, affect the construction and operation of the proposed Northern Railway Extension.

The locomotive fleet is in good condition and more than adequate for present and anticipated traffic levels. NamRail is currently rebuilding 15 locomotives, of which 5 have been completed.

Freight wagons average about 20 years old, are all bogie type with both plain and roller bearings and are well maintained. The overall fleet size is sufficient although additional units for specific traffic including containers, sulfuric acid, grain and cement may be required in the future.

Available passenger equipment is properly maintained and well in excess of the needs of the limited passenger service now operated.

All rolling stock is equipped with vacuum brakes, which limits train size and operating speeds but does not appear to be a serious problem at present. For NamRail to improve its competitive position relative to road transport, speed and capacity must increase so eventual conversion to air brakes should be planned.

A summary of the rolling stock roster is shown in Table 1.1

TABLE 1.1
NAMRAIL ROLLING STOCK

LOCOMOTIVES						
Type	Class	Number		Power		Year Built
		Roster	In Service	KW	HP	
Diesel Electric	32-200	6	6	1,340	1,800	1966
Diesel Electric	33-400	41	33	1,490	2,000	1968-70
Diesel Electric	33-500	4	4	1,490	2,000	1968-70

FREIGHT WAGONS				
Class	Number		Capacity	Year Built
	Roster	In Service		
Revenue	1,546	1,244	21 – 47.8 Tons	1940-86
Non revenue	78	N/A	N/A	1937-78

PASSENGER CARS				
Class	Number		Seating Capacity	Year built
	Roster	In Service		
Revenue	106	30	15-98	1965-82
Non-revenue	32	32	N/A	N/A

CONTAINERS		
Type	Number	
	Roster	In Service
Mini	299	299
3m (Various)	118	118
6 m (Various)	284	260
Tanks (Various)	30	30
Flat Racks	20	0
TOTAL	751	707

Note: See Appendix 1.4 for a complete roster

Table 1.2 shows the annual freight traffic by 5 year intervals from 1972 to 1997. As can be seen, traffic peaked in the 1970's and has declined dramatically and steadily since. This is a result of improved roads and increased truck competition and the shut down of some mines with the resulting loss of mining related commodities.

TABLE 1.2
1972 – 1997 FREIGHT TRAFFIC
NAMRAIL

Fixed Year	Gross Ton-Km (Millions)	Net Ton-Km (Millions)	Train Km (Millions)
1971/72	5,762	2,610	11.4
1976/77	7,112	3,246	8.5
1981/82	6,938	3,348	7.7
1986/87	4,522	1,836	5.6
1991/92	2,936	1,226	4.6
1996/97	1,846	970	3.2

In recent years, the railway system has carried about one-third of all freight traffic in Namibia. In 1997 this totaled 1.587 million tons of cargo and 0.969 billion ton – kilometers.

Major commodities hauled are mining products, bulk liquids and containers. In terms of ton-kilometers, the traffic is about evenly split between international (export and import) and domestic movements.

Passenger traffic in 1997 was 137,322 passengers and a total of 59.19 million passenger-kilometers.

Average traffic unit revenue forecast for 1998-1999 is:

Freight	N$0.18 ton/km
Passenger	N$0.12 passenger/km

Recent unit operating expenses (1998) are shown in Table 1.3.

TABLE 1.3
1998 UNIT OPERATING EXPENSES
NAMRAIL

UNIT	EXPENSE (N$)
Net ton/km	0.18
Train/km	59.56
Wagon/km	3.28
Loco/km	10.75

Total revenues for 1995-1998 were as shown in Table 1.4 and a breakdown, by function, of operating expenses denoted in Table 1.5 for the same years.

TABLE 1.4
1995-1998 REVENUE
NAMRAIL

CATEGORY	ANNUAL TOTAL (000)			
	1995	1996	1997	1998
Freight	152,316	161,274	159,952	164,560
Passenger	2,113	2,888	3,759	7,342
Equipment Rental	944	531	1,671	(660)
Miscellaneous Services	1,567	1,044	1,168	1,779
TOTAL REVENUE	**159,940**	**165,737**	**166,550**	**173,021**

TABLE 1.5
1995 – 1998 OPERATING EXPENSES
NAMRAIL

CATEGORY	ANNUAL TOTAL (000)			
	1995	1996	1997	1998
Infrastructure Maintenance	37,433	37,217	37,629	43,010
Operating Maintenance	101,293	103,197	119,759	119,615
Administration	7,587	9,885	10,564	10,557
Depreciation	2,174	2,965	4,347	4,360
TOTAL EXPENSE	**148,487**	**153,264**	**172,299**	**177,542**
OPERATING PROFIT (LOSS)	**8,453**	**12,473**	**(6,049)**	**(4,521)**

Although results for two of the past four years were positive, depreciation charges appear quite low and, over time, funds may not be available to replace permanent way and rolling stock, as it becomes necessary.

Train operations are directed from four control points located at Windhoek, Keetmanshoop, Walvis Bay and Otjiwarongo. There is no fixed block signal system; all train movements are controlled by radio authorization from the control points to the locomotive drivers. This type of train movement control is safe and perfectly adequate and used extensively on railways worldwide.

Major rolling stock maintenance is done in the main workshop in Windhoek. There is a small workshop at Walvis Bay and light repairs and routine inspections are performed at depots located at Otjiwarongo, Keetmanshoop and Ariamsvlei. Some maintenance functions are now performed by outside contractors.

Average freight train service operated on the various route segments, is shown in Table 1.6

TABLE 1.6
AVERAGE FREIGHT TRAIN SERVICE
NAMRAIL

Route Segment	Average Trains Monthly Both Directions
Nakop – Keetmanshoop	78
Keetmanshoop – Windhoek	174
Windhoek – Kranzberg	178
Kranzberg – Walvis Bay	208
Kranzberg – Otjiwarongo	82
Otjiwarongo – Tsumeb	54
Otavi – Grootfontein	48
Windhoek – Gobabis	70
Keetmanshoop – Aus	52
Aus – Luderitz	8
Otjiwarongo – Outjo	Out of Service

Trains operate with one or two diesel units and are restricted to 60 km/h generally because of track conditions, instability of Spoor Barber bogies on some wagons and the limitations of vacuum brakes. Permissible train length is 128 to 160 axles with limits of 800 – 1 400 tons per locomotive on the different lines. Average train size (in 1998) was 18 wagons and 72 axles totaling 690 gross tons.

The freight trains operated provide overnight service between main stations, for example Walvis Bay and Windhoek. There is also a premium international container service guaranteeing two-day transit time between Cape Town / Durban / Johannesburg and Windhoek.

Transit times for freight traffic between major stations appear to be reasonable: 1 day between Windhoek and Walvis Bay and 2 days between Walvis Bay and Keetmanshoop, for example. Turn around time for freight wagons, 9 days, is also in the performance range of other world railways.

Distribution of wagons as required by customers and location status is done manually but the system works satisfactorily. A computerized wagon control system is now being installed.

There are no dedicated passenger trains, but coaches are operated in overnight mixed trains on main routes as shown in Table 1.7

TABLE 1.7
PRESENT PASSENGER SERVICE
NAMRAIL

ROUTE	FREQUENCY	Km	TRANSIT TIME
Windhoek – Walvis Bay	Daily except Sat.	421	11:30
Windhoek – Keetmanshoop	Daily except Sat.	505	11:17
Keetmanshoop – Upington	Wed, Sat.	498	13:20
Windhoek – Gobabis	Sun, Tue, Thurs.	228	7:53
Windhoek – Tsumeb	Sun, Tue, Thurs.	602	15:50
Walvis Bay – Tsumeb	Sun, Tue, Thurs.	602	12:15

The rail passenger service offered is extremely slow and not competitive with bus travel. Bus service is also provided by NamRail between Keetmanshoop and Luderitz and Tsumeb and Oshakati.[1]

In addition to regular passenger service, NamRail operates several tour trains. These include trains of private firms (Shongololo, Rovos Rail and Union Limited) for which NamRail furnishes locomotives and crews and receives a set fee. The Desert Express is a luxury train running between Windhoek and Swakopmund and is owned and operated by NamRail. This service, which was inaugurated in April, 1998 is not yet profitable but ridership is increasing.

1.8 CHALLENGES FACED BY NAMRAIL

NamRail has some of the typical problems of railways in developing nations: light traffic density resulting in under-utilized infrastructure, rolling stock and staff and intense competition from trucks particularly as the road system has been improved.

Additionally, NamRail has lost much of the largest traffic base it had, because of the closing of several mining operations.

To some extent NamRail has kept close to the financial break even point by selling assets (locomotives for example), but this is only a short term solution.

The on-going re-organisation which will result in NamRail being operated in accordance with the factors that govern private sector businesses will not solve the problems of over capacity and high fixed costs. Nor will the soon to be implemented Road User Charges which, however, will increase costs to the trucking industry and will likely result in higher tariffs which should benefit NamRail.

NamRail must accomplish two things to survive over the long term and be a profitable enterprise:

1. Operate more efficiently at lower unit costs, which, in turn, will permit reduced tariffs that will attract more traffic.

2. Be considerably more innovative and responsive to the needs of customers.

[1] A Starline passenger schedule is shown in Appendix 1.5

The Consultant interviewed over 30 users of truck and rail transport and frequently the reason shipments went by truck was not costs, but service reliability and the general perception that trucking firms were more "customer friendly".

Rail service now provided is only marginally competitive with road transport charges and in most cases inferior in terms of transit times and customer services.

NamRail has a well maintained infrastructure and rolling stock fleet that can transport far more traffic than is now moved. Present staff is also adequate to handle considerably higher traffic levels.

Considering 1998 results, for example, if revenue had been 5 percent higher, while other costs increased 5 percent and labour costs held steady, NamRail would have shown about N$ 4.0 million profit rather than a loss.

Operating efficiency must be improved, service tailored to customer needs and transit times reduced if traffic levels are to be increased or even maintained at present levels.

The situation is serious, but can be corrected. Unlike many (if not most) railways in developing countries, the infrastructure and rolling stock are in good condition and no massive rehabilitation programs are needed. NamRail is also fortunate to have well trained staff and a turn around in traffic decline and financial performance could be accomplished fairly quickly.

2. TRAFFIC DEMAND FORECAST

2.1 FREIGHT TRAFFIC

2.1.1 Introduction

To determine the freight traffic that would be transported on the Northern Railway Extension it is necessary to:

- Establish the total traffic now moving in the corridor and estimate what will move in the future.
- Make an evaluation as to what percent of the total traffic could be diverted to rail.

The Northern Railway Extension will provide two opportunities for NamRail to increase traffic and revenue. One will be the capture of traffic now moving entirely by truck from Walvis Bay, Windhoek and beyond. The other will be extending the rail haul on traffic bound for the Four O Regions, which now travels by rail as far as Otavi and Tsumeb before being transloaded to truck.

With respect to long haul rail traffic from the south, NamRail will be able to offer significantly lower rates than truck and with reasonable service standards should capture some of this traffic. Regarding the extension of bulk commodity (mainly fuel) hauls from present transloading points at Tsumeb and Otavi, this will lower overall transportation charges and should capture most of the traffic.

2.1.2 Total Freight Transportation Market

In 1995 the Research Unit for Economic and Physical Distributions Studies (RTPS) prepared a report for NamRail entitled "*Construction of a Railway Line between Tsumeb and Oshakati*". This report contained an actual road traffic survey conducted at Oshivelo and Oshikango to identify traffic going to and from the Ondangwa, Oshakati and Oshikango areas as well as to and from Angola. The survey was conducted for seven consecutive days in two calendar months to provide a more representative sample of the traffic flow. After road traffic was identified, RTPS then made assumptions regarding how much traffic could be diverted to rail and three scenarios, "optimistic", "realistic" and "pessimistic" were developed. This 1995 traffic study was the starting point for the traffic and revenue forecast which follows. A synopsis of this traffic survey is included in Appendix 2.1.

The Consultant used the 1995 survey's identification of major commodity groups as an indication of where more detailed examination of both total market size and the potential for diversion from road to rail should be made to quantify regional freight traffic. This investigation included interviews with major shippers, truckers, freight forwarders and others. Interviewees were asked for estimates of the market potential of the Four O Regions, as well as the southern Angolan market. Shippers provided volumes, routing and truck rates. They also indicated the performance objectives (eg, transit time reliability) that they expect from transportation service providers and whether, and under what conditions they would use the proposed rail service. Thirty-three shipper interviews were conducted during February and March 1999. Most of the contacts were in the Windhoek area, but the Consultant also visited major wholesalers, retail distributors and bonded warehouses in the Oshakati, Ondangwa and Oshikango areas. Representatives of trucking firms and freight forwarders and the Namibian Ports Authority in Walvis Bay were also interviewed.

Following the assembly of pertinent data, the Consultant made an analysis and produced an estimate of total regional freight traffic. The tonnage estimate was significantly larger than that RTPS developed in its 1995 study. RTPS identified 431,480 annual tons of various commodities shipped into and out of the region (over 85% inbound), while the Consultant's current estimate is 587,900 tons (nearly all inbound). To a degree the difference between the two estimates is due to timing: movement of some commodities remained constant, but others have changed. For example, one brewer will soon open a bottling plant in Oshakati, which will require movements of bulk beer, glass bottles and packaging materials, while minimizing shipments of bottled beer. This alone will cause a significant change from the 1995 estimate. Also movement of some commodities – fertiliser, for instance - is seasonal and may not be moving when a survey is being made.

The total annual tonnage estimate for each commodity group is shown below. In sum, the estimates represent a synthesis of data and customer comments reviewed in the light of the Consultant's experience and judgement.

Fuel: 87,500 tons. This estimate was developed from comments of the five major petroleum product distributors in Namibia and includes liquefied petroleum gas. Most fuel is shipped by rail from Walvis Bay to depots in Otavi and Tsumeb before transshipment to truck for distribution in the Four O Regions. The exception is BP which receives all fuel by truck at its depot in Ondangwa.

Cement: 50,000 tons. This figure includes tonnage moving currently by rail from the RSA as far as Tsumeb where it is transshipped to truck. It also includes cement moving into the region from the cement manufacturing plant in Otjiwarongo. The figure was developed from comments of RSA and Namibian cement manufacturers and local distributors in the region.

Scrap: 5,000 tons. This figure was obtained from a major scrap dealer who assembles the material in the region.

Lubricants: 2,500 tons. This estimate was derived from comments of the five major petroleum product distributors in Namibia. Lubricants flow into the Four O Region by various routes. Some are shipped by rail to depots in Otavi or Tsumeb where they are transshipped onto trucks, while others are shipped directly by truck from Windhoek.

Aggregates: 72,000 tons. A major aggregate distributor in the region provided this estimate. As good quality aggregates are not available in the region, they must be imported from Tsumeb.

Glass bottles and packaging: 69,000 tons. This estimate includes requirements for existing cold drink bottling in the region and the supplies necessary for the new bottling plant and brewery that are to be built in the near future.

Maize meal: 76,000 tons. Imports of maize vary widely from year to year. This figure reflects an average of imports for maize between 1991 and 1997. The imported maize is processed into meal in both Windhoek and Otavi, prior to shipment to the north.

Bricks, kerbs and interlocks: 63,200 tons. This market figure was developed from comments from three brick manufacturers serving the region.

Sugar, bagged or packaged: 50,000 tons. This estimate was based on comments of a major sugar importer. It coincides relatively closely with the NamRail's 1995 estimate. Generally speaking, sugar flows from Walvis Bay in one-ton bags to packaging operations in Windhoek, Otavi and Tsumeb, prior to shipment to the north.

Bulk beer: 26,300 tons. As mentioned before, a major beer maker is planning to open a bottling plant in Oshakati in the near term. This figure represents the plant's requirement of bulk beer to move north in the not too distant future. The bottling plant and its production, therefore, are assumed here. This figure excludes approximately 78,000 tons of finished beer product (inclusive of beer, glass bottles, and packaging) which will cease to flow north when the plant opens. It must be mentioned that the primary competition for this beer maker is planning to open a brewery in the region in a time frame commensurate with that required for the construction of the rail line. That brewery, therefore, is assumed as well. The facility will obviate the need for movement of approximately 52,000 tons of finished beer into the region (half of which will likely be sold to the Angola market). At the same time it will require supplies of glass bottles, packaging, hops, and malts to be imported from the Republic of South Africa.

Perishables: 22,600 tons. In addition to traffic trucked north from Windhoek for distribution in the region, there are major shipments of onions and potatoes from the RSA going to Angola. This estimate was derived from comments of distributors in the region and from the Consultant's observations and enquiries at the Oshikango border crossing.

Furniture: 10,000 tons. This figure reflects the comments from a furniture distributor in the Four O Regions and represents a major increase from the volumes reported in the 1995 NamRail study. However, it is consistent with the distributor's observation of dramatic increases in furniture sales (much of which goes to Angola) in the recent two-year period.

Packaged beer: 10,000 tons. This estimate was derived from comments of various shippers and receivers. It consists largely of specialty products and lesser brands, which will continue to be distributed from Windhoek.

Other beverages: 8,900 tons. This estimate was developed from comments of the two principal cool drink bottlers in Namibia.

Steel: 6,000 tons. A steel distributor serving the region provided this market estimate, which includes imports of steel products (bars, angles, channels, reinforcing bar, tubing.) from Windhoek, the RSA, and Zimbabwe.

Electrical poles and equipment: 5,000 tons. NamPower advised that annual requirements for material would total about 5,000 tons in the study area for the maintenance of an existing power line and another that will be built within the next three years.

Cooking oil: 3,200 tons. As this commodity's volume could not be specifically confirmed for this study, the consultants relied on the tonnage estimated by NamRail in 1995.

Groceries: 1,900 tons. This figure was derived from comments of a major distributor in the Four O Regions. It coincides closely with the estimate developed for NamRail's 1995 study.

Fabricated metal products: 1,600 tons. These include metal door frames, windows, and other products. One shipper was contacted for the firm's volume estimate. This was increased to account for competition and market growth.

Fertiliser: 1,200 tons. A major distributor serving the region provided this market estimate.

Liquor: 1,000 tons. This estimate of wines and distilled beverages was derived from comments of distributors in the region.

Timber: 1,000 tons. This estimate was developed from comments of a major distributor in the region. It includes stock sourced in Windhoek and the RSA.

Hardware and electrical products: 1,000 tons. This estimate was derived from comments of a major distributor in the region.

Roofing sheets: 1,000 tons. This estimate was based on comments of a major distributor in the region.

Machinery and vehicles: 600 tons. This category includes road construction and earth moving equipment. One major shipper was contacted for the firm's volume estimate. This was increased to account for competition and market growth.

Machine parts: 300 tons. These are spare parts needed for the repair of road machinery and generator sets. One major shipper was contacted for the firm's volume estimate. This was increased to account for competition and market growth.

Plastic pipe: 200 tons. This estimate includes pipe being deployed as part of a major water project in the region. The pipe is manufactured in the RSA. A major distributor in the region provided comments from which this figure was derived.

Generator sets: 100 tons. One major shipper was contacted for the firm's volume estimate. This was increased to account for competition and market growth.

Miscellaneous containerised freight: 10,000 tons. This figure includes cargo originating in Walvis Bay and going to the region and to Angola. It also includes hops and malt from the RSA for the new brewery planned for the region. Freight forwarders provided estimates on the container movements from Walvis Bay and brewers provided estimates of hops and malt, which will be shipped from the RSA.

The commodities identified and forecast annual tonnages are summarized in Table 2.1.

2.1.3 Potential Diversion of Freight Movements to Rail

Once the total transportation market was estimated the Consultant made an analysis to determine what commodities now moving by truck would likely be diverted to rail. The starting point for this analysis was determining the primary transportation performance objectives that are sought by shippers. The performance objectives most frequently cited included:

- Reliable transit times. Speed is important, but may be outweighed by lower rates, for example;
- Secure and damage free handling of cargo;
- Door-to-door transportation of goods;
- Competitive pricing;
- Timely and accurate movement information on shipments; and
- Quick response to new or changing requirements of customers.

Overall, road transport typically meets those standards better than rail – or, at least that is the perception of customers. Trucks pick up and deliver goods at the plant or job site thereby expediting movements from origin to destination with minimal opportunity for delay and avoiding transshipment of cargo with inherent potential for loss or damage.

TABLE 2.1
TOTAL FREIGHT TRAFFIC NORTH OF TSUMEB

COMMODITY	ANNUAL TONNAGE
BASE COMMODITIES	
Fuel	87,500
Cement	50,000
Scrap	5,000
Lubricants	2,500
OTHER COMMODITIES	
Aggregates	72,000
Glass bottles and packaging	69,000
Maize meal	76,800
Bricks, kerbs and interlocks	63,200
Sugar: Bagged or packaged	50,000
Bulk beer	26,300
Perishables	22,600
Furniture	10,000
Packaged beer	10,000
Other beverages	8,900
Steel	6,000
Electrical poles and equipment	5,000
Cooking oil	3,200
Groceries	1,900
Fabricated metal products	1,600
Fertilizer	1,200
Liquor	1,000
Timber	1,000
Hardware and electrical products	1,000
Roofing sheets	1,000
Machine and vehicles	600
Machine parts	300
Plastic pipe	200
Generator sets	100
Miscellaneous containerized freight	10,000
TOTAL	**587,900**

Shippers indicated that they are generally satisfied with present truck service, but might ship by rail if there was comparable service and/or lower rates. As these service levels are what shippers are now getting and expect, it would appear that NamRail will need to offer approximately comparable service or lower rates in order to gain significant inroads in the Four O market. Accordingly, two scenarios were developed in order to bracket the potential for diversion of traffic to the proposed Northern Railway Extension. Scenario 1 assumes rail operations on the line would be similar to the existing NamRail system – with the sole exception that rates would be equalized in cases where rail prices now exceed truck. Scenario 2 would be a much more ambitious program that would include selective service improvements, significant rate reductions and a very aggressive marketing effort.

The Consultant then ascribed rail diversion percentages of the total traffic of the different commodities, partially based on the comments of shippers regarding the potential of using rail, but mainly relying on prior experience in similar transportation market situations.

Four "base" commodities were identified that are long haul and more price than time or service sensitive : fuel, cement, scrap and lubricants. These tend to move by rail under ordinary competitive conditions, and it was assumed that they would continue to do so on the extended line (as they do now, for the most part to and from Tsumeb) at current rate levels.

All "other" commodities are more time and service sensitive and will require significantly lower rail rates and, in some cases, service improvements if they are to be captured by rail. The one exception is aggregates which is normally price rather than service sensitive. In this case, however, the movement would be fairly short haul, from Tsumeb to the Ondangwa-Oshakati-Oshikango area and it will be more difficult for rail to capture the traffic.

All of the "other" commodity groups would be predominately shipped in containers – again, with the exception of aggregates which would move in open wagons.

The total freight traffic market for the two groups of commodities transported in the region is:

Base commodities:	145,000 tons
Other commodities:	442,900 tons
Total:	**587,900 tons**

The results of the traffic analysis and the freight tonnage that would likely be diverted to rail are shown below:

SCENARIO 1

Characteristics

- Service similar to current NamRail practice;
- Minor rate adjustments.

Base commodities:

Rail should capture 95% of three of the four base commodities (fuel, scrap and lubricants). The exception is cement originating at Otjiwarongo. Rail should also retain the cement traffic that is now moving from the RSA. This would result in an annual base commodity tonnage of 115,300.

Other commodities:

These commodities now move predominately by truck even on routes where there is competing rail service. There is little reason to believe that the Northern Railway Extension will capture a larger share of the market with existing rate levels in effect and no significant service improvements. Also, shippers are now using truck transport and it will take good reasons (lower rates, for example) and time – as well as a concerted sales effort by the railway to divert traffic.

For these reasons, it has been estimated that only an average of 5% of these commodities would initially shift to rail resulting in an annual rail tonnage of 20,200.

The forecast diversion to rail of each commodity is shown in Table 2.2.

SCENARIO 2

Characteristics:

- Selective service improvements
- Significant rate reductions on competitive commodities.
- Aggressive marketing.

Base commodities:

Rail traffic increases by 10,000 tons, because of a forecast rail diversion of Otjiwarongo cement. The rates on this cement traffic have been lowered to capture this movement. The base commodity tonnage is increased to 125,300.

Other commodities:

The "other" commodities group contains about 75% of the total traffic in the area and a fairly substantial segment of that can be diverted to rail by taking these actions:

1. Offer improved service to customers, i.e. faster transit times, adequate supply of equipment, prompt and accurate movement information and quick response to requests for new service or correction of problems.

2. Make selective and significant rate reductions for movement of commodities that have the best chance of being diverted from truck to rail.

3. Mount an aggressive campaign to market the railway's service.

When these commodities are diverted to rail nearly all will move in containers. This will eliminate any en-route transloading. Rates can be structured to provide for railway or shipper pick-up and delivery. The main issue is that the railway provide a service and rate package that is not significantly inferior to truck transportation.

In the judgement of the Consultant and comments received from shippers an average 20% rate reduction below truck tariffs should result in a substantial diversion of traffic to rail.

TABLE 2.2
SCENARIO 1
RAIL FREIGHT TRAFFIC FORECAST

COMMODITY	TOTAL TONS	DIVERSION TO RAIL	
		%	TONS
BASE COMMODITIES			
Fuel	87,500	95	83,100
Cement	50,000	50	25,000
Scrap	5,000	95	4,800
Lubricants	2,500	95	2,400
OTHER COMMODITIES			
Aggregates	72,000	0	0
Glass bottles and packaging	69,000	10	6,900
Maize meal	76,800	0	0
Bricks, kerbs and interlocks	63,200	5	3,200
Sugar: Bagged or packaged	50,000	5	2,500
Bulk beer	26,300	0	0
Perishables	22,600	5	1,100
Furniture	10,000	10	1,000
Packaged beer	10,000	5	500
Other beverages	8,900	10	900
Steel	6,000	5	300
Electrical poles and equipment	5,000	50	2,500
Cooking oil	3,200	5	200
Groceries	1,900	5	100
Fabricated metal products	1,600	5	100
Fertilizer	1,200	5	100
Liquor	1,000	5	100
Timber	1,000	0	0
Hardware and electrical products	1,000	5	100
Roofing sheets	1,000	5	100
Machine and vehicles	600	5	0
Machine parts	300	5	0
Plastic pipe	200	10	0
Generator sets	100	5	0
Miscellaneous containerized freight	10,000	5	500
TOTALS	**587,900**		**135,500**

Note: Rail traffic less than 100 tons per annum has not been included.

TABLE 2.3
SCENARIO 2
RAIL FREIGHT TRAFFIC FORECAST

COMMODITY	TOTAL TONS	DIVERSION TO RAIL	
		%	TONS
BASE COMMODITIES			
Fuel	87,500	95	83,100
Cement	50,000	70	35,000
Scrap	5,000	95	4,800
Lubricants	2,500	95	2,400
OTHER COMMODITIES			
Aggregates	72,000	20	14,400
Glass bottles and packaging	69,000	40	27,600
Maize meal	76,800	30	25,000
Bricks, kerbs and interlocks	63,200	30	19,000
Sugar: Bagged or packaged	50,000	20	10,000
Bulk beer	26,300	30	7,900
Perishables	22,600	10	2,300
Furniture	10,000	30	3,000
Packaged beer	10,000	30	3,000
Other beverages	8,900	30	2,700
Steel	6,000	30	1,800
Electrical poles and equipment	5,000	70	3,500
Cooking oil	3,200	30	1,000
Groceries	1,900	30	600
Fabricated metal products	1,600	20	300
Fertilizer	1,200	40	500
Liquor	1,000	30	300
Timber	1,000	40	400
Hardware and electrical products	1,000	30	300
Roofing sheets	1,000	40	400
Machine and vehicles	600	30	200
Machine parts	300	10	0
Plastic pipe	200	20	0
Generator sets	100	10	0
Miscellaneous containerized freight	10,000	40	4,000
TOTALS	**587,900**		**253,500**

Note: Rail traffic less than 100 tons per annum has not been included.

Diversion will vary between commodities and lengths of haul; traffic with origins in the RSA is estimated to be attracted to rail at double the rate of traffic that originates within Namibia. This is because a percentage rail rate reduction will have a much larger effect on the total cost of a shipment.

Included in this total is 14,400 tons of aggregates originating at Tsumeb. While this is short haul traffic, it is reasonable to assume that, with reduced rates, rail will capture 20% of the total market.

Overall it is forecast that about 29% of the total "other commodities" category of freight can be captured by rail with a combination of rate reductions, service improvements and aggressive marketing. This would result in an annual rail movement of 128,200 tons of the "other commodity" group.

The total freight forecast for traffic diverted to rail under the conditions set forth in Scenario 2 is shown in Table 2.3 (page 2-9).

2.1.4 Summary of rail freight forecast

Under the conditions set forth for Scenario 1, it is anticipated that about 24% of total freight movements will shift to rail if the Northern Railway Extension is built, resulting in a annual tonnage of 138,000.

If the railway pursues a policy of making selective rate reductions, improving service and aggressively marketing its transportation product, the total percentage diverted will increase to 43% of the total market as forecast in Scenario 2. The total tonnage resulting is 253,500 per year.

These results are summarized in table 2.4.

TABLE 2.4

SUMMARY OF RAIL FREIGHT FORECASTS

COMMODITY GROUP	TOTAL	DIVERTED TO RAIL	
		SCENARIO 1	SCENARIO 2
Base commodities (cement, fuel, scrap, lubricants)	145,000	115,300	125,300
Other commodities (all other commodities	442,900	20,200	128,200
TOTALS	**587,900**	**135,500**	**253,500**

It has not been possible to assess the annual growth of freight traffic in the light of experience over the past 20 years (see Table 1.2) but there is no doubt that the figures reflected in Table 2.4 could be increased should the necessary upgrading in service, as will be described in Section 8, be initiated and sustained.

There are three major factors that would create increased rail traffic:

- Population growth
- Commercial and industrial development
- Increased trade with Angola

Increased Angolan traffic could result from a cessation of hostilities and the transport of more consumer goods into the country, or longer term, a rail connection to CFM at Cassinga. Either of these developments should increase rail traffic to the border – particularly containers – routed through Walvis Bay. To attempt to forecast when (or if) either of these possibilities will happen is risky.

Commercial and industrial development will take place, but the type, timing and extent to which rail transport will be utilised are difficult to predict.

Population growth is, however, a certainty and estimated at 6% per annum in the near future. This will cause an increase in the need for consumer goods, much of which should be transported by rail.

Based mainly on the population growth factor, a conservative estimate of a rail traffic increase of 3% per year has been included in the revenue forecast over the 20 analysis period.

2.2 PASSENGER TRAFFIC

2.2.1 Introduction

Figures in the National Transport Development Plan (1997) indicate that an average of about 396 passenger trips are made daily by scheduled bus in the proposed rail corridor. It is also estimated that about the same number of daily trips are made by minibus and taxis. Thus, there is a total of about 800 riders daily in the corridor.

The railway offers three day per week service with coaches included in mixed trains and carries about 25 passengers per trip between Windhoek and Tsumeb and 40 per trip between Walvis Bay and Tsumeb. NamRail has a bus service beyond Tsumeb to Oshakati, but the connections are not convenient.

Busses and taxis provide direct service overnight (10 hours) whereas the present rail service only as far as Tsumeb requires about 16 hours. Although economy class rail fares are cheaper than bus, the service is simply too slow and inconvenient to attract much traffic.

Starline Passenger Service haulage costs are N$2-80 per coach/km and the present traffic between Windhoek, Walvis Bay and Tsumeb fails to cover the costs. There is no good reason to believe that an extended service to Ondangwa or beyond would do better until transit times are dramatically shortened.

2.2.2 Passenger Service Options

Because there is some demand for rail passenger service now to Tsumeb, it is likely that there would be some travelers on the line after it is built to Ondangwa or beyond. However, extending the tri-weekly service now provided to Tsumeb to the new northern terminus should more than cover the demand. And, this service will, at best, generate enough revenue to cover operating costs. For this reason, detailed costs and revenues for the extended passenger routes have not been developed.

One new passenger service option that appears to warrant further study is implementation of a weekend only round trip between Windhoek/Walvis Bay and Ondangwa. If trains consist only of coaches equipped with Commonwealth bogies, speeds on much of the line could be raised to 100 kph. If these trains made stops only at the larger towns, a 12–14 hour schedule between Windhoek/Walvis Bay and Ondangwa would be possible. North of Tsumeb, the train would stop at Oshivelo, Ondangwa and a limited number of other halts at locations that would be determined in consultation with the local authorities. At present rail fare levels, this could attract a reasonable number of passengers.

A Friday evening Windhoek/Walvis Bay to Ondangwa train with a Sunday evening return could be operated with a ten coach train north of Kranzberg and five coaches on the trains between Windhoek and Kranzberg, and Walvis Bay and Kranzberg. The financial break-even point would be about 500 passengers and this would appear to be an achievable goal with the greatly reduced transit time.

Tourism is another potential source of passenger traffic. The proposed railway will pass very close to the eastern border of Etosha National Game Park and a combined rail-bus service could be attractive to tourists. A tourist package such as now operated by Shongololo Express should be explored. Such a service would not generate a great deal of revenue, but it would produce some net earnings for the railway.

With respect to the higher speed proposed, trains can be dangerous to motorists and pedestrians operating at NamRail's present maximum speed of 60 kph. Raising the speed to 100 kph would require a public educational program, particularly in the communal area, to make people aware of the potential hazard.

2.2.3 Recommended Passenger Service

It is recommended that passenger service on the new line be an extension of the one coach, three day per week mixed train operation now offered to and from Tsumeb.

It is also suggested that a weekend round trip train between Windhoek/Walvis Bay and Ondangwa be operated on an experimental basis. If this service is a success, weekday passenger trains could be considered, as well. It should be noted, however, that the proposed weekend service, even with favourable ridership will initially be about a break-even financial operation.

3. OPERATIONS

3.1 GENERAL

3.1.1 Construction Sequence

The Northern Railway Extension would be built in three phases:

Phase 1 : Tsumeb to Ondangwa

Phase 2 : Ondangwa to Oshakati

Phase 3 : Ondangwa to Oshikango

The lines beyond Ondangwa could be built as required; i.e. either the segment to Oshakati or Oshikango could be built first and the timing would be determined by the development of traffic sources.

3.1.2 Route Configurations

Phase 1:

The line would be single track originating at the existing station at Tsumeb with the junction to the new route approximately 2.2. km west of the station. New stations would be located at Oshivelo and Ondangwa. Two additional crossing loops would be included midway between Tsumeb and Oshivelo and Oshivelo and Ondangwa, respectively. Halts would be established for passengers at other appropriate centers of population which would be determined in consultation with community leadership.

3.1.3 Train Size, Axle Loads and Operating Speed

Present tonnage and axle limits on line segments south of Tsumeb are shown in Appendix 3.1.

Because the terrain on the new line will be virtually flat and curves will be minimal, train tonnage and number of axles will be the maximum allowed on NamRail which is 1,900 tons and 140 axles for either one or two locomotives. As noted in Section 5, design will allow axle loading of 18.5 tons and maximum operating speed of 100 kph. Although these axle loads and speeds are greater than now permitted elsewhere on NamRail, it is anticipated that the entire system will eventually be upgraded to these standards to increase operating efficiency and to effectively compete with road transport.

3.1.4 Train control System

Train control will be the same as now used on NamRail, that is radio transmitted train orders to drivers. This is a system with which personnel are familiar and there is no reason to change as it is safe and efficient.

3.2 PRESENT OPERATIONS SOUTH OF TSUMEB

Under present operations, one train daily, 6 days per week, operates each way between Walvis Bay and Otjiwarongo and between Windhoek and Otjiwarongo. Three days per week each train carries a passenger coach in mixed service with the freight wagons. On the days the mixed train operates, the allowable train mass and axles are restricted. Under present traffic levels, train size restrictions are not limiting wagon movements. Usually, these trains require only one locomotive but about two days per week a second locomotive is required out of Walvis Bay to move available tonnage. The Windhoek traffic level presents no problem for movement with a single locomotive. Additional trains are operated (particularly from Walvis Bay) when traffic warrants.

Trains 9607 / 2607 departs from Walvis Bay at 16:25 Monday through Saturday and arrives at Otjiwarongo at 03:15. Train 9666/6666 departs from Windhoek at 17:50 Sunday through Friday and arrives at Otjiwarongo at 04:20. After the trains are shunted, local cars removed and the mechanical inspection is made, Train 9666/6666 departs at 05:35.

Cars are classified for Train 9966/6666 to Tsumeb with blocks made for Otavi, Grootfontein and Tsumeb.

Three days per week (Monday, Wednesday and Friday) the coach from Walvis Bay is included for through movement to Tsumeb.

At Otavi, Train 2707 from Grootfontein meets 9966/6666. The Grootfontein crew takes the Otavi and Grootfontein block of wagons and spots the wagons at Otavi industries, then returns to Grootfontein to complete its deliveries to industries.

Train 9966/6666 arrives in Tsumeb at 09:40. The Tsumeb shunter will have already completed the morning industrial and goods shed work and assembled the outbound train at the station platform. After Train 9966/6666 arrives, crews are exchanged and after passengers disembark, the shunter crew backs out the arriving train and finishes the morning goods shed and industrial work. Train 9613/2213 then departs at 10:30 for Otjiwarongo making pick-ups of wagons along its return route.

If the up train from Tsumeb is late, the Tsumeb shunter crew departs from Tsumeb with the down train and meets the up train enroute where the crews exchange trains and return to their respective terminals.

At the present traffic levels, tonnage for the Tsumeb train only occasionally exceeds timetable limits. When this occurs an extra train is run to Otavi to handle the excess tonnage.

A review was made of a two-week sample period (January 18 – February 2, 1999) of trains actually operated between Windhoek and Otjiwarongo, Walvis Bay and Otjiwarongo and Otjiwarongo and Tsumeb. The results are shown in Table 3.1.

TABLE 3.1
CHARACTERISTICS OF TRAINS OPERATED
JANUARY 18 TO FEBRUARY 02, 1999

Line Segment	Total Trains Northward (Up)	Number of Locomo-tives		Average Train Size		Timetable Limits			
						1 Locomotive		2 Locomotives	
		1	2	Mass	Axle	Mass	Axle	Mass	Axle
Windhoek-Otjiwarongo	13	11	2	477	50	820	64	1340	108
Walvis Bay-Otjiwarongo	18	11	7	829	77	730	56	1340	108
Otjiwarongo-Tsumeb	12	9	3	873	87	840	60	1340	108

Notes:
1. Mass and axles are limits for mixed trains. Trains without passenger coaches have slightly higher maximums.
2. Mass and tonnage limits are shown for up trains as this is the heavy tonnage direction.

As can be seen, Windhoek-Otjiwarongo trains average well under allowable mass and axles, even for single locomotive ratings. Walvis Bay-Otjiwarongo trains average somewhat over the one locomotive limit but, again, well under two locomotive ratings. Otjiwarongo-Tsumeb trains average slightly over single locomotive limits, but well under that permitted for two units.

A survey made of operations south of Windhoek indicated trains operating on this route also normally have less mass and fewer axles than the limits and no increased trains or locomotive usage would normally be needed.[1]

Requirements for additional trains, increased locomotives, freight wagons and passenger coaches are discussed in Sections 3.3 and 3.4.

[1] See Appendix 3.1 for present mass and axle limits for all line segments

3.3 PROPOSED TRAIN OPERATIONS

3.3.1 Service Design

The planned train operations are for Phase 1, which contemplates the new line being built only to Ondangwa. However, the proposed train operations are designed so that extended service to either Oshakati and Oshikango or both can be readily added in the future.

Generally, the trains north of Tsumeb will be scheduled to connect with the present trains operating south of Tsumeb. A six day per week train will be operated in each direction as shown in the proposed schedule shown in Table 3.2

TABLE 3.2
PROPOSED SCHEDULE

TRAIN NO.			UP		DOWN	
			DEP. DAILY x SAT		DEP. DAILY x SUN	
			9966/6666	9907/2607	9901/2201	9912/2612
PRESENT SCHEDULE	WINDHOEK	D	18:50		05:20	04:00
	WALVIS BAY	D		16:25		
	OTJIWARONGO	A	04:20	03:15	17:50	16:45
		D	05:35		15:00	
	TSUMEB	A	09:40		10:30	
PROPOSED SCHEDULE	TSUMEB	D	10:25		09:00	
	ONDANGWA	A	14:55		04:30	
			ARR. DAILY X SUN		DEP.DAILY X SUN	

The new train between Tsumeb and Ondangwa would carry a coach three days weekly to provide the same passenger service as is now offered south of Tsumeb. This should be sufficient until train transit time is reduced to be more competitive with busses and taxis.

Train crews will do their own shunting at Ondangwa. This work will not be great and no additional shunter crew is warranted.

3.3.2 Characteristics of Freight Trains

As mentioned, one train, Monday through Saturday would be operated in each direction between Ondangwa and Tsumeb, carrying a passenger coach on alternate days.

Based on the traffic forecasts developed in Section 2, average train mass and number of axles would be as shown in Table 3.3 for Scenarios 1 and 2.

TABLE 3.3
AVERAGE TRAIN MASS AND AXLES
TSUMEB TO ONDANGWA

Scenario	Average Train Size		Proposed Limits 1 or 2 Units	
	Mass	Axles	Mass	Axles
Scenario 1	754	56	1,900	140
Scenario 2	1,543	130	1,900	140

Note: 1. Only the up direction from Tsumeb to Ondangwa has been considered as this is the heavy traffic direction.

2. See Appendix 3.2 for calculations.

As can be seen, on an average basis, one locomotive can handle each train and six trains per week will accommodate the traffic forecast for either Scenario 1 or 2. However, traffic does not move evenly and there will be peak days. For the Scenario 1 situation, the average traffic is so far below capacity that it is assumed that one locomotive on a six day per week train will suffice.

However, for Scenario 2, two locomotives per train are provided to improve running time for heavier trains and 2 extra trains weekly have been estimated to accommodate peak traffic.

3.3.3 Effects on Trains South of Tsumeb

The increased traffic beyond Tsumeb will obviously affect train size south of Tsumeb as was noted in Section 3.2. A summary of the effects and the modifications to operations required to handle the added traffic are noted in Table 3.4 for both Scenarios 1 and 2.[2]

TABLE 3.4
MODIFICATIONS IN TRAIN OPERATIONS SOUTH OF TSUMEB

Line Segment	Modifications Required	
	Scenario 1	Scenario 2
Upington – Windhoek	No additional trains or locomotives required	One additional locomotive 260 trips per year
Windhoek-Otjiwarongo	1 additional locomotive 52 trips per year	1 additional locomotive 312 trips per year
Walvis Bay-Otjiwarongo	1 additional locomotive 402 trips per year	1 additional locomotive 402 trips per year
Otjiwarongo-Tsumeb	1 additional locomotive 78 trips per year	1 additional locomotive 78 trips per year 52 extra trains per year

The added costs associated with these additional locomotives and trains are calculated in Section 7.

3.3.4 Additional Passenger Service

A possibility for increased passenger service that would be a weekend round trip between Windhoek/Walvis Bay and Ondangwa has been considered. This service would only be attractive to

[2] See Appendix 3.3 for a summary of increased mass and axles on line segments

customers if transit times were substantially reduced to allow a late afternoon departure and early morning arrival which would require a maximum travel time of about 12 to 14 hours.

This is possible and a five car train, with a capacity of approximately 350 passengers could be operated with one locomotive on an experimental basis. The train would leave Windhoek Friday evening at about 18:00 and arrive in Ondangwa around 07:00 Saturday making stops only at the larger towns. The return trip departing Ondangwa Sunday evening would be on a similar schedule.

This train if operated, would do no better than break even financially, but could provide a worthwhile public service.

3.4 ROLLING STOCK REQUIREMENTS

3.4.1 General

All locomotive, freight wagon and passenger coach requirements have been calculated on an incremental basis; that is, what additional rolling stock will be required to handle the forecast traffic increase compared to that now used to handle the current traffic volumes.

These calculations were made for both movement of goods on the new Northern Railway Extension and the added movements on lines south of Tsumeb.

3.4.2 Locomotives

The locomotives that will be needed to power trains on the new line, as well as additional units required to move increased traffic on lines south of Tsumeb were calculated on the basis of data discussed in Sections 3.3.2 and 3.3.3.

The additional locomotive usage is summarised in Table 3.5 and details are shown in Appendix 3.4.

TABLE 3.5
ADDITIONAL LOCOMOTIVE REQUIREMENTS

Line Segment	Annual Additional Locomotive Days	
	Scenario 1	Scenario 2
Ariamsvlei – Windhoek	0	260
Windhoek-Otjiwarongo	52	416
Walvis Bay – Otjiwarongo	402	402
Otjiwarongo – Tsumeb	110	110
Tsumeb – Ondangwa	312	624
Total Days	876	1, 812
Average number of Locomotives	2.4	4.3
25% Out of Service Allowance	0.6	1.1
Total Additional Locomotives	**3.0**	**6.2**

At present, NamRail has a total locomotive roster of 51 units. Of these, 43 are currently in service, 3 are awaiting wreck damage repairs and 5 are stored. Normal daily requirements are from 36 to 38 units plus 2 units assigned to the Desert Express and Rössing Mine. If the Northern Railway Extension begins operations, it will probably be necessary to re-activate the units now stored but no locomotives will need to be acquired.

3.4.3 Freight wagons

The analysis of freight wagon requirements was done on a similar basis as that used for locomotives: What additional wagons would be required to handle traffic to the Northern Railway Extension compared to present needs?

For Scenario 1 and 2 it was calculated that increased wagon requirements would be as indicated in Table 3.6.

TABLE 3.6
ADDITIONAL FREIGHT WAGON REQUIREMENTS

Type of Wagon	Additional Requirements	
	Scenario 1	Scenario 2
XPJ-16 (Tank)	12.2	12.2
DZA-9 (Gondola)	4.6	16.1
SMJ-1 (Container Flat)	2.7	27.3

Note: These figures do not include equipment for freight originating in the RSA. It has been assumed that Spoornet will furnish this rolling stock.

For traffic levels forecast in Scenario 1 no additional freight wagons should be required. The biggest increase will be for fuel tanks (Type XPJ-16) and there is a surplus of these available. The increase in open gondola (Type DZA-9) and container flats (Type SMJ-1) is minimal and the existing car fleet should accommodate this small increase.

Scenario 2 forecasts for tank wagons are the same as Scenario 1 and, again, should be readily accommodated by the present stock of wagons.

There is a significant increase in the need for open gondolas (Type DZA-9) but it is the Consultant's judgement that the present car fleet, with good management, can accommodate the requirements.

Appendix 3.5 shows the calculations for additional wagon requirements.

Container flats (Type SMJ-1) will be in short supply. Although it has been observed that many container flats are transported only partially loaded with containers, there will be a need for more wagons. These wagons could be converted from stock cars, which are presently stored in substantial numbers and it is estimated that at least 20 wagons should be converted.

3.4.4 Containers

Estimated container requirements are noted in Table 3.7.

TABLE 3.7
ADDITIONAL CONTAINER REQUIREMENTS

Type of Container	Additional Requirements	
	Scenario 1	Scenario 2
6 m "Pallet Friendly" Box	5.1	47.2
3 m Insulated Tank	0	17.5

Note: These figures do not include equipment for freight originating in the RSA. It has been assumed that Spoornet will furnish this.

With respect to containers, the additional number required for Scenario 1 should easily be accommodated by the present roster of equipment.

In Scenario 2, however, there will be a significant increase in requirements for 6 m containers that will require additions to NamRail's present supply. It is estimated that 20 x 6m containers should be acquired.

Also, it is forecast that a substantial amount of bulk beer will be transported from Swakopmund to Ondangwa and this will require acquisition of approximately 20 x 3 m insulated container tanks.

Appendix 3.6 outlines how additional container requirements were estimated.

3.4.5 Passenger Coaches

NamRail has over 30 coaches stored that can be placed back into service with relatively minor rehabilitation.

3.4.6 Rolling Stock Requirement Summary

Generally, NamRail has sufficient locomotives, freight wagons and passenger coaches to accommodate the increased traffic that will result for Scenario 1 if the Northern Railway Extension is built but some additional rolling stock will be needed for the traffic forecast in Scenario 2.

It may be necessary to reactivate 2 to 4 locomotives from storage status, convert some surplus wagons to container flats and refurbish 2 or 3 passenger coaches.

No wagon acquisition however, should be necessary except for possible conversion of covered cars to container flats.

With respect to containers, it will be necessary to acquire 20 x 3 m insulated tanks and at least 20 x 6 m "Pallet Friendly" steel dry containers.

The costs of these improvements and acquisitions to the rolling stock fleet are included in the capital costs discussed in Section 6.

3.5 TRAIN CREW REQUIREMENTS

For the Scenario 1 increase in off-line operations, only 2 added crews weekly would be needed between Otjiwarongo and Tsumeb. For Scenario 2, 4 added crews per week would be required between Windhoek and Otjiwarongo and 1 additional between Otjiwarongo and Tsumeb. The current train crew staffs at these terminals should be able to cover this additional work.

The additional personnel required at Ondangwa to operate the proposed trains for Scenario 1 and 2 are noted in Table 3.8. The costs associated with these crew members have been included in the operating costs described in Section 7.

TABLE 3.8
TRAIN CREW REQUIREMENTS AT ONDANGWA

Position	Additional Requirements	
	Scenario 1	Scenario 2
Driver	2	3
Assistant	2	3
Passenger Attendant	1	1

3.6 STATION AND FACILITY REQUIREMENTS AND OPERATIONS

3.6.1 Station and Crossing Locations

In Phase 1, there will need to be stations, with both freight and passenger facilities, only at Oshivelo and Ondangwa. At Oshivelo, there will be a crossing loop and an ancillary track in addition to a small station building and freight shed.

At Ondangwa there will be more extensive facilities that will include:

- 3 ancillary tracks with the capacity to hold approximately 100 wagons
- Passenger booking and accommodation facilities
- A freight shed fully equipped to handle containerized and wagon load goods

- A fully equipped container handling facility that can load and unload 3 to 12 m containers of maximum legal weight. The terminal will have a 40 t gantry crane as well as mobile equipment to handle all sizes of containers
- Offices and accommodation for staff
- A fuelling and storage track for locomotives.

A sketch of the proposed Ondangwa Station layout and others is shown on Plan No 81361/19.

The main functions to be performed at Ondangwa will be:

- Unload/load OPX containers
- Customer contact
- Prepare freight bills, bills of lading
- Input movement information into computer system
- Supervise shunting
- Supervise crew/other personnel assignments
- Sell passenger tickets, passenger information
- Deliver and pick up OPX
- Fuel locomotives

Much of the station related work will replace that now done at Tsumeb. It is anticipated that personnel will be transferred from Tsumeb to supplement the seven employees now stationed at Ondangwa and other than the addition of security officers, no new positions will be needed. At Oshivelo, only one clerical employee will be required, initially.

As previously mentioned a limited number of halts for passengers will be located at points determined in consultation with community leadership.

When the number of trains operated increases, additional crossing loops will no doubt be required, but this will be sometime in the future.

The cost of all phases of station operations and employee relocation expenses have been included in operating expenses and capital costs, as appropriate.

3.6.2 Maintenance Facilities

There will be no rolling stock maintenance facilities or personnel located on the new extension except for the locomotive fuelling and storage track noted in the previous section. The limited locomotive fuelling required will be done by tank truck delivery.

3.7 CONTROL AND COMMUNICATIONS REQUIREMENTS

Train control will be conducted as is now done by radio communications between train dispatchers and drivers. The required radio repeater locations, station installations, mobile units and handsets will be provided.

Stations will be provided with appropriate telephonic equipment to provide adequate voice and data communication capabilities to provide access to the existing NamRail communications network.

3.8 INFRASTRUCTURE AND COMMUNICATIONS MAINTENANCE

The force required for maintenance of track, structures and the radio system was estimated with the assistance of NamRail staff.

Permanent way personnel would include one Permanent Way Inspector and 14 general workers and trackmen. Crews will be provided with the necessary vehicles, equipment and hand tools.

One communications technician would be assigned to the territory to maintain the radio system.

4. ENVIRONMENTAL AND SOCIAL IMPACT ISSUES

4.1 INTRODUCTION

One of the most radical changes in Namibia since Independence is the official recognition that people are the country's most important and valuable resource and that they should participate fully, as partners of Government, in their own and in the country's development. Therefore people have to acquire the necessary information and skills and receive support to make informed choices, use opportunities to improve the quality of their lives and manage their lives and their natural and social environment in a sustainable way. Projects such as the extension of the railway line into the Four O Region, community water projects and labour based road building projects all create an opportunity for a range of skills development and practical experience in the process of planning, implementation and management of projects and their impacts to ensure that those affected also benefit.

The development of people and the Regions can only be successful if new development ideas and projects fit into the overall plan for the area and are perceived by the people of the area as their own and to their benefit. Therefore the people living in the project area, their concerns and expectations and their ability to manage the social, cultural, economic, political and natural impacts of the railway should be a cardinal focus of the study and should be part of the whole process of planning and implementation, monitoring and evaluation. This study forms the first stage of this process.

In this section of the report potential significant social and environmental impacts, based on a review of environmental baseline conditions for the regional study area and an immediate rail corridor impact study area of the proposed rail extension project, are addressed. This is followed by an overview of possible mitigation and monitoring measures for unavoidable negative impacts.

4.1.1 Project Description

Detailed descriptions of the project are presented in Sections 1, 3 and 5 of this report. In general this project is defined as an extension of the existing railway line from Tsumeb to Ondangwa, Oshakati and Oshikango in Northern Namibia.

4.1.2 Definition of Immediate Route Corridor and Regional Service Impact Study Areas

For purposes of collection of data and analysis regarding baseline environmental and social conditions, two study area definitions were utilised.

For background data regarding socio economic characteristics, demographic data and available quality of life statistics, a regional service impact study area was defined to include the Four O Regions of Ohangwena, Oshikoto, Oshana and Omusati.

For more site-specific data collection concerning sensitive natural or ecological sites and other points of interest and land use characteristics, the definition of an immediate route corridor impact study area was utilised. This area consisted roughly of five hundred to one thousand meters on either side of the proposed reservation area, following roughly Trunk Road (TR)1/10 and TR1/11 in Oshikoto, Oshana and Ohangwena regions and Main Road (MR) 92 in the Oshana region.

4.1.3 Project Justification and Need

Namibia has good road and rail connections with South Africa, but only road links with the other bordering countries of Angola and Botswana and beyond.

The proposed rail line will link the study area directly to Windhoek and will greatly benefit TR1/10 and TR1/11 by reducing the number of heavy vehicles operating on this road. It is anticipated that if this rail extension project materialises, the study area has the potential for evolving into the centre of trade between Namibia and Angola, as well as other SADC countries.

A rail network to connect Namibia and Angola, will enable the exchange of freight and passengers and the sustainable development between the two economies and their transport networks. In particular Walvis Bay in Namibia could serve as a gateway not only for these two countries, but also for the other countries of the region. The link from Ondangwa to Oshikango is also designed to facilitate the transportation of heavy goods to and from the Export Processing Zone (EPZ) at Oshikango.

With regards to Namibia, the main objective of the project is to stimulate economic growth in the northern regions especially with respect to the agricultural and manufacturing sectors. Better transport links and market chains could facilitate the transformation of the agricultural sector, which presently is largely subsistence based, into a more viable commercial-oriented sector. Subsistence agriculture is the main activity of the majority of the people throughout the northern regions and any improvement within the sector will therefore have a major impact. This is in line with Government policy of eradicating rural poverty and enabling the participation of all economically active Namibians in economic activities. The rail project would also contribute to the implementation of the *"Namibe-Lubango-Oshikango-Walvis Bay Development Corridor"* proposed by the Governments of Namibia and Angola. This area is regarded as a critical development area to promote economic growth, poverty eradication, employment and general development in southern Angola and north-central Namibia.

The conveyance of people to and from the north-central regions, now being conducted largely by busses, mini-busses and private cars, would be attracted to trains being more affordable and safer. The rail mode of passenger and freight transport in Namibia is receiving strong Government attention and support as a matter of policy outlined in official transportation plan needs for the Four O Regions.

4.1.4 Review of Project Area Conditions

Population Characteristics

As indicated elsewhere in the report the proposed railway route runs though three of the Four O Regions. It will cross commercial and communal land with the greatest part of the route (from Oshivelo to Oshakati and Oshikango) running through communal land. These two areas are very different from each other in terms of the socio cultural and natural environment, human capacity and economic opportunities. Some of these differences are directly related to pre Independence policies, others are the result of the natural and socio cultural factors.

Since Independence the Four O Regions, especially the area classified as communal, has benefited from the major change in developmental focus (increase in infrastructure, improvement of health, educational and training and business opportunities) and freedoms and opportunities granted through the Namibian Constitution. However it is an area in transition with regard to

leadership (Regional Councils and the traditional leaders), landownership, sustainable land and resource use and urbanisation. All this makes it imperative to find out from the people how they will manage the impact of the railroad and how they will benefit from these impacts

The 1999 population of the Four O Regions is estimated to be about 800,000, representing over 45% of Namibia's population, which is estimated at 1,800,000. The total population in the census enumeration areas on both sides of the proposed route (Tsumeb–Ondangwa, Ondangwa – Oshakati and Oshakati-Oshikango) is estimated to be 113,000. Only half of this number is expected to be directly affected by the proposed railway line, especially with regard to economic, social and environmental issues.

People live in dense concentrations in urban and semi-urban centres along main roads or in rural villages. Rural villages are formed by dispersed homesteads. The proposed route passes through rural areas situated between Tsumeb and Oshivelo (commercial farming area) and Oshivelo and Onathinge (communal farming areas). Between Onathinge and Oshakati the route passes through a densely populated area with urban concentrations around Ondangwa, Ongwediva and Oshakati. Along the route from Ondangwa to Oshikango the route passes through rural areas of varying population density.

New community water projects either currently being implemented or in the planning phase are expected to result in an increase in population density along the route of the railway line. This is in particular expected in the area between Oshivelo and Onathinge, along TR1/11, where three settlements have been identified as growth centres by the Regional Council of Oshikoto. These centres are Omutsegwonime, Omuthiya and Onyati and are all inside the direct impact area of the railway line. This fresh water supply in a saline area is expected to have a major impact on the provision of services such as schools and clinics which will be followed by the establishment of businesses, financial services as well as the proposed railway line. A population growth of at least 6% per annum can be expected in these areas.

Based on the 1993/1994 Household Income and Expenditure Survey, per capita income of the households in the areas is estimated to vary between N$ 4,085 and N$ 5,453 per annum (compared to a national median annual income average of N$ 6,233). It is possible that these figures may have increased as there has been considerable commercial growth in the main centers of Oshakati, Ondangwa and Oshikango. There is, however, no available data to substantiate the conjecture. The National Planning Commission has commissioned a follow-up study, starting in April 1999. The majority of people in the area are employed either in subsistence farming or Government institutions. There is also a flow of funds into the area in the form of pension payments and other cash remittances. The 1998 Namibia Human Development Report indicates that Ohangwena Region has the lowest national per capita income (N$ 1,070), Oshikoto Region the fourth lowest (N$ 1,680) and Oshana the sixth lowest (N$ 1,922). However all three Regions are above the Namibian average life expectancy rate (61 years), have literacy rates higher than the national average (81%) and school enrollment higher than the national average (85%). On the Human Development Index Ohangwena ranks the second lowest, Oshikoto the fourth lowest, and Oshana the seventh lowest of the thirteen Regions. On the Human Poverty Index Ohangwena ranks the lowest in the country, with Oshikoto and Oshana the sixth and the eight lowest respectively.

With regard to the socio cultural issues, the Ovambo ethnic group is made up of seven tribal kingdoms. Kingdoms are divided into districts and wards which fall under the jurisdiction of senior headmen. Villages fall under the authority of individual headmen. A homestead is headed by the household head. The clan structure is matrilineal but patrilocal.

Despite the rapid urbanisation in the area agriculture and pastoralism continues to form the basis of society. The agricultural calendar regulates the social life throughout the year. Cattle continues to form the most important part of the clan structure as they can be inherited whereas to date, land in communal areas cannot. Cattle are therefore raised with an emphasis on increasing the herd-size and the wealth and status of the owner. This wealth is used for the payment of debts or compensation and for ceremonial purposes.

Traditional and Regional Administrative Authorities

The four Regions, like all Namibian Regions, are governed by elected Regional Councils, chaired by Governors. Regional Councils act as the legal and recognised decision making bodies of the Regions and provide a link between local communities and the central government. The institution of the Regional Government structure is part of the decentralisation process. The Regional Council will, according to the Regional Council Act of 1992, develop regional plans in cooperation with the National Planning Commission. Planning would concern areas such as

- Population settlement and urbanisation
- Exploitation and development of natural resources
- Development of infrastructure
- Land utilisation
- Environmental protection

A Five Year Development Plan has been prepared by the Oshikoto Region and the other two Regions are in the process of developing such plans. It is important that the railway line fits into the planning of the three Regions.

Because of a lack of human and financial resources the process of decentralisation has been delayed and as a result many of the functions of the Regional Councils continue to be carried out by Central Government. The planning and the implementation of the railway line project should be used as an opportunity for capacity building in the three Regions.

The relationship between the elected and the traditional leadership is that of a partnership. This partnership has a positive impact on the Regions and will facilitate the full involvement of the communities within the immediate impact area of the railway line.

Land Use Issues

Historically the development of the natural potential of the area north of the Veterinary Cordon Fence which is communal land, was limited to an agro-silvipastoral economy. This system is heavily dependent on actual annual rainfall, the seasonal migration of livestock and the sustainable use of forest and natural products. The seasonal shallow pans, oshanas, have also been important sources of fish for people and grazing for livestock. The southern section of the Oshikoto Region, up to the Veterinary Cordon Fence, comprises large cattle farms with a few cultivated areas around lake Otjikoto.

Of special importance in regard to the farming activities in the communal area is the fact that it is general practice to move livestock from the densely populated homestead farming areas to and from grazing fields in the eastern and northern parts of Ohangwena and Oshikoto during the period

from July to December. Generally this movement is across the route of the proposed railway line. It should also be born in mind that there is a continual movement of livestock around the homestead areas to and from water points so that cattle and their herders will be crossing the railway line at many places along the route. The experience in the past has been that fencing has not been an effective means of control, as fencing was removed almost as fast as it was erected. The cost and time involved in erecting and protecting fences may be too high for some communities and they may opt for other protection measures. For example, after extensive consultations in 1995 between the Directorate of Rural Water Supply and communities living along the proposed canal between Ogongo and Oshakati it was decided that the canal would not be fenced. The communities opted for a large number of crossings at places convenient for pedestrians, vehicles and livestock.

The Four O Regions can be divided into four distinct land use patterns, being

- The south-eastern part consisting of the former magisterial district of Tsumeb characterised by commercial farms with Tsumeb as the main centre, serving the agricultural hinterland and in which infrastructural and social services are well developed.

- The north-eastern and south central parts, consisting of communal land which is sparsely populated with many small villages scattered throughout the areas and with only some basic infrastructural and social services.

- The north-central parts, also of communal land, which is very densely populated with towns such as Oshakati, Ongwediva, Ondangwa and Oshikango and the numerous villages serving the area, with some infrastructural services, but not as well served as the area around Tsumeb.

- The western part, not included in the study area, which is also communal land, less densely populated than the north eastern part, served by towns such as Outapi and Ruacana and numerous villages, but with a lower level of infrastructural services than the north-central area.

Settlement patterns consists of ribbon development along the major roads in the area with concentrations around Tsumeb, Omuthiya, Ongwediva, Ondangwa, Oshakati, Ohangwena, Eenhana, Oshigambo, Outapi, Okahao and Ruacana and the areas along the three proposed routes have become densely populated. Based on the 1991 census, it is estimated that about 13% of the population lives in the urban areas. This estimate is probably too low as there has been considerable migration to towns in the study area and in the south of the country over the last nine years.

The Four O Regions have experienced a steady decline in rainfall since the beginning of the 1980s. This, combined with the war and natural migration of people into uninhabited areas in the eastern part of Oshikoto, has led to a decrease in the number of big game. Only elephant seem to be still moving into eastern Oshikoto and, although this happens infrequently, the railway line will nevertheless cross an ancient migratory route between Oshivelo and Omutsegwonime. With the installation of community water points in Omutsegwonime and the areas to the north, an increase in elephant crossings may occur.

Development Characteristics

No section of the proposed railway line will cross pristine wilderness area. The area south of the Veterinary Fence has been degraded by a long history of commercial farming and shows bush encroachment, while the area to the north of the Veterinary Fence is the most densely populated area in Namibia. As a result virtually no part of the land along the proposed route has either not

been cultivated, trampled and grazed by livestock or altered by some other human activity. Due to population pressure, the entire northern part of the study area shows severe signs of degradation in form of deforestation, overgrazing, soil erosion and uncontrolled waste disposal. This is particularly evident around towns and other population centres. Existing larger, built-up roads such as the TR1/10 and TR1/11 and MR 92 have altered the natural drainage patterns, although mitigative measures have been put in place during recent construction projects.

In addition to the proclaimed road system consisting of paved, gravel and earth roads, the northern part of the study area has a vast informal track system connecting homesteads, villages and urban areas. The settlement pattern along the major paved trunk roads and the lack of any barriers such as fencing, has created a situation where vehicles cross, turn onto and turn off roads wherever they like. Pedestrians and livestock also cross roads wherever they like. Experience on the canal between Oshakati and Ogongo completed in 1996 has shown that in spite of identifying "official" crossing points for vehicles, people and livestock, communities living along the canal added a number of permanent informal crossing points and erected their own structures at these crossings. The same could be happening where communities or individuals view official crossings as inconveniently situated.

Regarding public transport services, the area is currently served by a few bus operators serving routes between Windhoek, Oshakati, Ondangwa and Oshikango. There are many taxis, but they do not adequately serve areas located along unpaved roads. Consequently transport problems in the rural areas are generally acute, in particular during the rainy season.

The study area has benefited since Independence from the rural electrification policy. However, in spite of major developments, it is estimated that only ten percent of the potential consumer public currently draws power from the supply system because of affordability and accessibility. An Electricity Master Plan has been drawn up and is awaiting final approval from Government. A major part of the rural community still relies on the burning of wood. Supplies from these natural sources have been seriously reduced as the forest areas have become denuded.

There has been very little industrial development in the proposed railway line area, mainly due to the lack of raw materials for processing. The main business activities within the railway line area relate to trading and services and small scale crafts such as basketry and pottery. It is expected that these activities would expand with time. There are very few tourism and recreation facilities in the northern part of the study area. This however is receiving attention with the development of conservancies. The first one to be proclaimed is situated south of the Okashana training centre and will form an additional point of entry, but this time from the north, into the Etosha Game Park.

Other services such as education, health and medical, water, postal and communication, law enforcement and banking are not yet adequate to the need, especially in the rural parts of the area to be traversed by the railway line.

Agricultural Characteristics

Agriculture is the most important sector of the economy and provides for the livelihood of more than 80% of the population. The agriculture practised in the Four O Region is characterised by the dualistic tenure system in the country. The route to be traversed from Tsumeb to Oshivelo will pass through areas that are farmed commercially and these farms are owned by individuals or companies. The route from Oshivelo to the destinations of Ondangwa, Oshakati and Oshikango passes through communal land that in terms of the Constitution of the Republic of Namibia belongs to the Government. However this land is administered by the local tribal headmen consistent with tribal traditions. Generally the commercial farms are worked by modern, capital intensive farming

methods. The farms are utilised to rear both small and large livestock, with some hunting and tourism as additional income-generating activities.

The communal holdings are generally farmed as mixed farming units, on which crops are produced and livestock grazed. In addition there are some holdings that consist of household plots only. Recently there has been a marked increase in illegal fencing of large areas on the traditional communal grazing areas in the eastern part of the Oshikoto Region by individuals, often outsiders to the area. This activity can only be stopped or managed once the Communal Land Bill has been passed. The farming methods are generally of a traditional nature with hand cultivation more common than mechanical methods. The relocation of people in the communal areas will be far more extensive than in the commercial areas.

Land Acquisition Issues

In respect of the designated reservation areas for the proposed railway line, impact issues vary considerably depending on whether the route is situated in the communal or the commercial areas. In the commercial areas from Tsumeb to Oshivelo it will be necessary to obtain rights of way over the properties and the servitudes will need to be negotiated with the owners of the properties.

The rest of the route, from Oshivelo to Oshakati and Oshikango presents a very different situation. In terms of the Constitution of the Republic of Namibia, ownership of the land in the communal areas rests with the government, but the use of the land is controlled by local traditional practice, which varies considerably form locality to locality. As a general rule the Kings and the headmen have the authority to allocate land for use by the people living within the jurisdiction of their areas. This allocation of land involves the right to use the land in accordance with local practice. Questions of inheritance rights also affect the issue. Land needed for activities other than residential and farming requires a "Permission to Occupy" (PTO) issued by the Ministry of Lands, Resettlement and Rehabilitation.

As part of more detailed environmental investigations to be carried out during the next phase of the design process, it is recommended that a Land Acquisition Action Plan (LAAP) be established. This action plan should address appropriate procedures and methods to establish a fair and equitable compensation programme consistent with Namibian land acquisition policies. This should be accomplished through comprehensive community participation of project affected persons with the involvement of regional, local and traditional leaders, including interested and affected parties such as various Ministries in the Region and in Windhoek. The objective would be to establish consistency and fairness regarding land acquisition compensation matters. Most likely, procedures now used by the Department of Works, Transport and Communication for acquiring right of way for roads would be followed.

4.1.5 Methodology and Approach

The interested and affected parties for the initial scoping were limited to the Environmental Authorities and Ministries, Regional Councils, Senior Traditional Leaders and environmental experts. With regard to the Regional leadership, this approach is in line with the policy of decentralisation and capacity building in the Regions, and the recognition of the uniqueness of the Regions and their different development agendas.

The preliminary nature of the study dictated the methodology used. The data collection was limited to policy documents and reports, meetings with community leaders and environmental experts and field reconnaissance trips. The data collection and environmental and social impact issues review, occurred between mid January and late April 1999.

This report addresses important issues and the next steps necessary in the environmental approval process under Namibian guidelines. A Terms of Reference (TOR) for further more detailed environmental and social impact studies is included in Appendix 4.1 and outlines several tasks and other activities required for a full environmental assessment as proposed by the Ministry of Environment and Tourism (MET).

Concerning social and human environmental issue identification, the Consultant held consultative meetings with the Regional Councils and traditional leaders of the Oshikoto, Oshana and Ohangwena Regions and conducted field reconnaissance surveys.

Natural and physical environmental impact issues were identified during a four day reconnaissance field survey from 23-26 March 1999, consultations with relevant experts and a literature review. The vegetation as an indicator of habitat was recorded along the proposed route corridor on either side of TR1/10 and TR1/11, from Tsumeb to Oshikango and along MR 92 to Oshakati. An attempt was made to follow a direct line from Oshakati to Engela to assess the vegetation and land use along that route. Because of flooded oshanas, the actual route followed was slightly west of the route proposed for the railway alignment. Notes were made on the vegetation and general land use, and co-ordinates of vegetation boundaries and land use changes, as well as natural environmental points of interest were recorded. Voucher plant specimens have been lodged with the National Herbarium of Namibia in Windhoek.

Details of individuals consulted and data sources are presented in Appendix 4.2.

4.1.6 Issues Identified and Attitudes Regarding the Proposed Railway Line

The following range of issues, reflecting local and national concerns, were raised by the representatives of the communities in the Four O Region and the environmentalists. The Leadership of the Oshana, Ohangwena and Oshikoto Regions indicated that they were aware of the proposed railway line and that this development has their full support. However they raised a number of issues impacting on the design, implementation and future management of the project.

Social Issues

- The need for the railway line to be an integrated part of the overall development of the three regions. Local leadership should be involved and take part in joint decisions.
- The need to create short and long term jobs in the rural areas. Although people should not be used as a pool of cheap labour, as many jobs as possible should be created at reasonable, labour based salaries.
- Compensation for land in both commercial and communal areas should be equitable, paid only for cultivated land (in communal areas) and only to people now living there and not to opportunists moving in later.
- Adequate protection for people and livestock.
- Members of the community should be the major beneficiaries of the project.
- The local population need to be informed about plans. The leadership wants to play an important coordinating role in the project.

- The many successful projects previously implemented in the Four O Regions should be used as guidelines for the labour based work methods and land compensation.

The environmental specialists consulted, suggested the following issues be examined in detail in the next phase:

Natural Environmental Issues

- The potential obstruction of wildlife migration routes
- Impacts during the construction phase

Legal issues

- Land acquisition and compensation: The Ministry of Lands, Resettlement and Rehabilitation must be consulted early on during the final design process.
- The Environmental Management Act (1998) is still pending. Formal procedures regarding co-ordination/co-operation between Ministries is therefore pending regarding environmental assessments.

Namibia's Environmental Assessment Policy of 1995 prescribes the need for an Environmental Impact Assessment for any developments with potential negative impacts on the environment. One of the many activities requiring an impact assessment is the construction of railways according to guidelines published in 1995 under the Ministry of Environment and Tourism. The Ministry of Works, Transport and Communication adapted the implementation of environmental assessments in its 1993 Environmental Manual.

Namibian policy addressing land acquisition and resettlement is currently pending regarding communal and commercial land procedures. It is likely that staff from the Department of Water Affairs, the Ministry of Lands and Resettlement and Rehabilitation (MLRR) and the Ministry of Regional and Local Government and Housing (MRLGH) would be involved in monitoring all impacts regarding resettlement, land acquisition and compensation of project affected persons. They may also be involved along with the project proponent agency and the Regional Councils in setting up compensation policy and re-establishment of existing farmers along the route regarding land acquisition needs for the project.

In any event, the Department of Works, Transport and Communication has had a great deal of experience acquiring land for roads and has procedures that can be followed.

4.1.7 Alternatives Considered

Alternatives to the Project

The Terms of Reference for this study specified that the purpose was to evaluate the feasibility of constructing a railway connecting Tsumeb with Ondangwa, Oshakati and/or Oshikango. Thus, the only transportation alternative – improved or increased road transport – was not a consideration.

Alternatives within the Project

The alternatives within the project considered the topography and land area through which the railway will pass, in this case characterised by an extremely flat plain of low relief averaging 1,100 m above sea level. This area is traversed by shallow low gradient watercourses (oshanas), which originate several hundred kilometers north of the border in Angola. Oshanas have no defined flood channels. The water courses form a delta about 130 km wide and drain from the Angola-Namibia border as a shallow trough from north to south towards the Etosha Pan.

A major flood (efundja) in the central oshanas occurs only infrequently (every 3 to 4 years) when heavy rains fall over the entire Angolan catchment area. In order to provide a suitable roadbed, it will be necessary to raise the track above ground level and provide frequent culverts to allow sufficient natural water flow and drainage.

Alternatives within the project consisted of evaluating several route options that best serve the market and provide maximum overall benefits, while minimising total investment and operating costs including avoidance or minimisation of adverse environmental impacts.

Rail engineering route selection and design criteria were utilised in determining possible route alternatives. This criteria included, but was not limited to:

- Serving the major population centers of Oshivelo, Ondangwa, Oshakati and Oshikango following roughly the same alignment as TR1/10 and TR1/11 and MR 92.
- Limiting or avoiding disruption of drainage flow areas associated with the oshanas and flood plains extending from Angola.
- Avoiding or limiting impacts on known valuable natural resource environmental sites, including human settlements.

The following route options were evaluated and considered in regard to the optimum phased construction program.

- Tsumeb - Ondangwa
- Ondangwa - Oshakati
- Ondangwa - Oshikango
- Oshakati - Oshikango

The Oshakati - Oshikango alternative was dropped from further consideration on both economical and environmental impact grounds. The associated costs regarding mitigation of impacts with respect to the flood plains and oshanas including social impact costs are likely to be very high in comparison to the other alternatives in which these impacts are important, but less significant in scope.

4.2 DESCRIPTION OF BASELINE SOCIAL AND ENVIRONMENTAL CONDITIONS

Included in Appendix 4.3 of this document is a full description of existing baseline environmental and social conditions. These conditions have been obtained through initial consultations, available documented resources and field surveys. Existing environmental and social conditions are presented according to the following main topics in the appendix of this report.

4.2.1 Human/Economic Development and Quality of Life Conditions

Regional population; population of selected communities in the region; characteristics of existing human and economic development; descriptions of services and other quality of life or socio-economic characteristics, including land use conditions and descriptions of existing degradation of the natural environment related to the built environment are described.

4.2.2 Natural Conditions

Flora and fauna species, habitats and wildlife status are listed.

4.2.3 Physical Conditions

Geology and landforms, soils, climate, water quality, air quality, noise and hydrological conditions are described.

Places of interest and natural features are shown in Plan 81361/25 and historical and cultural sites of interest shown in Plan 81361/26.

4.3 POTENTIAL IMPACTS AND MITIGATION MEASURES

All major construction projects, such as the construction of the proposed project railway line, are associated with impacts on the environment.

Primary impacts are related to the construction process, are localised and can usually be minimised or mitigated.

Secondary impacts are associated more with the operation phase and can be far reaching and cumulative.

Included in Appendix 4.4 of this report is a presentation of potential impacts and mitigation measures. These are reviewed for construction (primary impacts) and operations (secondary impacts) of the proposed rail extension project.

The following environmental and social impact issues were identified and reviewed:

- Human/economic development and quality of life issues
- Public and livestock safety impacts
- Air quality impacts

- Noise impacts
- Soil and erosion impacts
- Water quality and drainage (hydrological) impacts
- Plant and animal impacts
- Historical and cultural impacts
- Aesthetic considerations
- Waste disposal impacts

Potential significant environmental impacts requiring further study both for the construction and operating period of the proposed rail extension project include:

- Land acquisition and project affected person impacts
- Public and livestock safety impacts
- Soil and erosion impacts
- Water quality and drainage (hydrological) impacts
- Public safety and severance impacts
- Waste and disposal impacts

Impacts regarding the following parameter items were judged at this time not to be significant provided mitigation measures are implemented. They should, however, be re-evaluated during the final design process:

- Aesthetic considerations
- Plant and wild animal impacts
- Noise and vibration impacts
- Air quality impacts

In summary, the following are general guideline measures for design, construction and operation of the proposed rail project.

Measures during design include:

- Preparation of a land acquisition action plan which includes careful appraisal of property values to ensure fair, equitable and adequate compensation to owners and communal land constituents.

- Assistance to residents and businesses that are forced to relocate
- Proper design of drainage structures to keep track levels above Efundja flood levels
- Provision of bridges and drainage structures to preserve natural flow of waterways
- Consultation with community, traditional and elected leaders to improve the progress of the project and to locate adequate vehicle, pedestrian and animal (domestic and wild) crossings to minimise severance problems.

Measures during construction include:

- Adequate sprinkling of roads and work areas to minimize dust
- Provision of temporary roadways through or around construction areas
- Restricting working hours to day time in residential areas
- Control of the movement of construction vehicles to minimise traffic congestion
- Provision of sedimentation ponds and other means to avoid siltation of drainage areas and oshanas
- Maintenance of orderly work sites
- Consultation with the community to report on progress and resolve issues of concern.

Before the regular operation of trains start, the following activities to promote safety are suggested:

- Hold community meetings to inform and discuss proposed operations
- Implement a public awareness program including visits to schools in the area to explain to local residents and particularly to children about the potential hazards related to train movements
- Liaison with local TV and radio stations, newspapers and churches to publicise information about the start of operations, scheduling and safely issues.

4.4 ENVIRONMENTAL MANAGEMENT AND MONITORING PROGRAM ISSUES

4.4.1 Introduction

This initial environmental evaluation report has identified the main issues and sources of environmental concern regarding the new railway extension project. To reduce or mitigate any unavoidable adverse effects, mitigation measures have been outlined. An environmental management and monitoring programme is discussed below for consideration during the final design, construction and operational phases of the project.

4.4.2 Detailed Design Phase Issues

More detailed designs are needed to identify the precise magnitude and nature of environmental impacts of the selected route and final decisions must await the outcome of such studies. The number of households and persons to be relocated will be established with more precision and plans to reduce social impact and to provide displacement assistance and compensation will be in accordance with government policy. This will involve surveys of likely affected people and more in depth participation of leadership at the community level.

The movement and behaviour of people and their livestock along and across the route of the railway should be studied. This information can help identity the need for design modifications or alterations to construction procedures.

The reservation area required for eventual railway use should be identified and staked out to clearly solicit comments and concerns, so adjustments can be accommodated early to avoid delays in construction.

The hydrological aspects of railway design should take full account of the need for flood water and the usual rain water passage. Hydrological structures, such as drainage culverts and bridges, should be designed with generous openings to ensure that there is sufficient capacity to cope with seasonal drainage water.

4.4.3 Construction Phase Issues

During the construction phase, a variety of mitigation measures to protect people and the environment should be planned. To reduce dust dispersion caused by construction activities close to communities, measures such as water sprinkling should be implemented. Work time for construction activities near sensitive areas should be limited to daytime hours, where possible.

Because construction may cause soil erosion and sedimentation problems, activities should be concentrated during the dry season to the extent possible, when impact issues associated with the oshanas and seasonal drainage flooding can be avoided or minimised.

4.4.4 Monitoring Program

A monitoring program should be established before construction of the project begins. The purpose should be to verify that social and natural environmental objectives are achieved and that mitigation measures are effective. This programme should address both construction and operations monitoring issues.

A committee should be formed to monitor the environmental effects of the project from planning through construction to the start of operations. To ensure that environmental control measures are effective during construction, a monitoring program should be established to oversee the process. This monitoring program should also be addressed as construction contract specifications. The monitoring program will not need to be highly complex or time consuming. It could be conducted by representatives from the appropriate environmental and project proponent authorities, the regional and local governments and persons who live or operate businesses along the route.

The main focus of the monitoring should be to ensure that construction noise is not excessive, that most of the construction takes place during the daytime; that water sprinkling and other measures are effectively used to hold down dust; that construction materials and stormwater sediments are

not being transported into drainage areas, and that effective waste management procedures are being implemented.

A noise monitoring program should be established to ensure that control measures are being employed and that night-time activities do not create unreasonable disturbances to any nearby residential areas.

Water quality should be monitored at any boreholes or hand dug wells close to the construction area and any permanent or seasonal drainage channels associated with oshanas leading to them from the project area. Parameters of concern are suspended solids, turbidity, oil and grease and biochemical oxygen demand.

A waste disposal programme needs to be established, monitored and accompanied by an environmental awareness campaign.

After the start of operations, the primary effort of monitoring will be to verify that all necessary precautions are taken to ensure the safety of people and their livestock. This will require, at a minimum an intensive educational programme, particularly for children.

4.5 CONCLUSIONS

4.5.1 Irreversible and Irretrievable Commitments of Resources

This rail transport development project will require the commitment of certain physical, natural, financial and human resources for its construction and operation. Many of these resources will not be available for alternate uses or will not be readily convertible. They include, but may not be limited to land, materials, fossil fuels, labour and capital required for construction of trackwork, bridges and culverts, earthwork and level crossings, buildings, platforms and communications facilities. Other resources will be required for handling equipment and maintenance during operations.

Implications of using such resources are not anticipated to be critical or in short supply immediately or in the future and their use for this project will not result in a need to divert resources from more socially, economically and strategically important uses.

4.5.2 Potential Direct Benefits

The immediate route corridor area, the surrounding areas and Namibia itself will benefit from the improved quality of transportation resulting from proposed project action. These benefits include improved accessibility to markets and employment, safety, savings in travel time, reliability and comfort.

This rail extension project should result in the following potential direct benefits:

- Stimulation of economic development (eg. new businesses, employment, housing, better markets and access to public services)
- Savings in transport operating costs for both passenger and freight traffic

- Reduction of accidents, both fatal and property damage due to less congestion on nearby existing roads and also on main roads south of Tsumeb
- Increased comfort and convenience for users
- Reduced operating costs of transport vehicles using existing roads due to reduced congestion
- Reduced vehicle traffic, especially heavy trucks that will decrease road maintenance expense.

4.5.3 Potential Indirect (Secondary) Benefits

It is likely that in the long term the following indirect benefits of the project will include:

- More competitive conditions that could lower costs of consumer goods
- Expansion of trade and industrial activity in the project corridor impact area
- Inducement of additional investments
- Creation of new long-term employment opportunities
- General enhancement of the health and quality of life conditions in the Four O Region .

4.5.4 Summary of Potential Environmental Impacts

A summary of the potential impacts and suggested mitigation measures for construction and operation of the new railway line extension is shown in the appendix.

An assessment of the overall potential gains from implementation of this rail extension project particularly as related to the economic benefits to shippers and passengers and the secondary benefits of economic growth and development to economies of the region and nation cited elsewhere in this report, outweigh the few temporary and longer term unavoidable negative environmental and social impacts identified. This initial environmental evaluation indicates that the unavoidable adverse impacts identified can be successfully mitigated.

In order to comply with Namibia's Environmental Policy, the detailed design phase must include an Environmental Assessment, which will include:

- Public consultations involving potential project affected people and further meetings/consultations with interested and affected parties, such as various Ministries, regional and traditional leaders.
- Detailed baseline surveys of project affected persons, land acquisition and compensation needs, flora, fauna, archaeological and ancestoral sites, for the immediate corridor area.
- Detailed mapping of the proposed route
- Monitoring programme based on final designs.

The Terms of Reference recommended by the Ministry of Environment and Tourism (MET) to address more detailed environmental and social impact investigations of the issues outlined in this report is presented in Appendix 4.1.

5. ENGINEERING

5.1 INTRODUCTION

The terrain in the study area is flat and the population density in the rural area is generally low. Development is mainly along the highway linking Tsumeb with Ondangwa, Oshakati and Oshikango. The design of the horizontal and vertical alignment of the railroad is therefore relatively easy in terms of engineering input.

Initial freight volumes on the railroad will be low and the construction costs will be critical when determining the economic viability of the project. Innovative engineering solutions are therefore required to reduce cost by evaluating the economic advantages of second hand rail versus new rail and effectively using labour based and localised construction methods.

The towns of Ondangwa, Oshakati, Ongwediva and Oshikango are the main developing centres in the northern Regions. Layout plans of these towns have been included in this study to identify planned formal development and to locate the rail alignment accordingly. Land required for the rail line and stations within these town boundaries needs to be reserved at an early stage to facilitate co-ordinated planning.

5.2 ROUTE SELECTION

5.2.1 Procedures followed

- Available Plans

  Topographical plans to a scale of 1:50 000 with contour intervals of 10 m, were obtained from the Surveyor General. Detail layout plans of Oshivelo, Ondangwa, Oshakati and Oshivelo were obtained from the Ministry of Regional and Local Government and Housing and local Town Planners.

- Meetings with concerned parties.

  Meetings or discussions were held with :

  Ministry of Works, Transport and Communication

  Ministry of Defence

  Ministry of Regional and Local Government and Housing

  NamRail

  Town Planners in Oshakati and Ondangwa

  Nampower

  Namwater

  Regional Governors, Local Authorities and Headmen.

- Site Inspection

  A number of site inspections were conducted and an aerial reconnaissance of the entire route from Tsumeb to Ondangwa, Oshakati and Oshikango made.

- Route selection

  With the available information and necessary engineering input, a tentative route was then selected and plotted on the 1:50 000 Topographical Plans and Layout Plans at Towns.

- Tentative approval

  The selected alignment, proposed crossings with trunk and district roads and other details were then discussed with the Ministry of Works, Transport and Communication and tentative approval obtained.

5.2.2 Route Options Considered

The existing bitumen surfaced highway is the only land link between Tsumeb, Ondangwa, Oshakati and Oshikango. In the communal area, a water pipeline parallels TR1/11 and MR 92 most of the distance. As a result, most of the area population resides, and commercial development has taken place in this corridor. Locating the railway immediately next to the road would require relocation of many homesteads and commercial establishments as well as being more hazardous to people that if the rail line was located farther northeast.

The terrain in the study area is flat and the topography has little influence on the route selection. TR1/10 and TR1/11 between Tsumeb and Oshikango and MR 92 between Ondangwa and Oshakati therefore are the logical corridors to be followed.

In the absence of a development corridor between Oshakati and Oshikango, economic activity is restricted to subsistence farming. Various oshanas traverse this route and drain water in the rainy season from Angola in a southern direction towards Oshakati. Because of the low population density and relative high cost to construct a rail line through oshanas, a line extension to Oshikango from Ondangwa, rather than Oshakati would be preferable from an engineering standpoint.

5.2.3 Alignment Selection Considerations

- Tsumeb to Oshivelo Gate (Refer to Plan No. 81361/01 through 04)

  This section of the railway will traverse commercial farmland with very little development next to TR1/10 influencing the rail alignment.

  For a distance of 13 kilometres north of Tsumeb, the terrain to the west of the road is hilly compared to the flat terrain to the east, which is preferable for the construction of a rail line.

  Because this is a commercial farm area, the rail line will need to be fenced and it would be undesireable to isolate a strip of land between TR1/10 and the railway. For this reason the proposed alignment from Tsumeb to Oshivelo will be immediately adjacent to and on the north-east side of TR1/10.

  North of Oshivelo the gameproof fence of the Etosha Game Reserve is situated to the west of TR1/11 and the rail line therefore also needs to be to the east of the road.

  From Otjikoto to Okatopi, 30 km south of Ondangwa, a 132 kV powerline with a 35 m wide servitude is located about 400–500 m east of the road. Because of homesteads and commercial development closer to TR1/11 the rail line will follow the route of the existing 132 kV powerline. It is proposed to place the rail line some 50 m to the east of the powerline in order for the rail reserve to border the powerline servitude.

Level crossings will be provided where the rail alignment intersects the access roads from TR1/10. These are DR 3007, DR 3005, DR 3001 and FR 3009. Rail crossings at District Roads and Farm Roads will be regulated by roadsigns. Higher traffic volumes on the access road to Tsumeb and the close proximity to the town warrant that this crossing be signalised, and regulated by mechanical boom.

Some 2 km south of Oshivelo, the rail line will cross the Omuramba Owambo where a concrete river bridge will be provided.

- Oshivelo to Ondangwa (Refer to Plan No. 81361/05 through 10)

  This section of the line will traverse communal land. The local population has been attracted to TR1/11 for commercial reasons and the availability of water from the pipeline adjacent to the road.

  The majority of houses are built within 200 m of the road with a natural pedestrian flow towards the road and water pipeline, as well as alongside the road to schools, shops, etc. To build the rail line adjacent to the road reserve will bring rail traffic in conflict with pedestrian traffic, as well as with animals concentrated at watering points. Furthermore, a great number of houses would have to be demolished and people resettled. If the rail line is constructed a few hundred meters away from the road, most of these problems will be minimised whilst the line will still be within easy walking distance from most villages.

  Again it is proposed to follow the powerline servitude some 400 m northeast of TR1/11, for the following reasons:

  - As stated previously, the Etosha Game Reserve fence restricts infrastructure development to the west of the road.

  - Future development in Ondangwa, where a station is required, is mainly to the northeast of the road.

  - Should, in the future, the traffic on district roads necessitate the construction of a road over rail bridge, there would be adequate space available between TR1/11 and the rail line to accommodate such a bridge.

  At the Oshivelo Military Base the railway needs to follow the powerline between the road and the base since there is a shooting range to the east of the base.

  Larger villages, for instance Onyaanya and Onyati, extend to the east of the power line servitude and the rail line will have to be diverted around the villages.

  Where the rail alignment intersects DR 3630, DR 3603 and access roads to villages, level crossings will be provided with road signs. Peak traffic on DR 3622 to Oniipa, which is in excess of 200 vehicles per hour, warrants a grade separated crossing.

  About 12 km north of Oshivelo the rail line crosses the Omuthiya River where a bridge will be provided.

  Okatopi is a main power distribution station and here the rail line crosses two 55kV powerlines to the east and north.

  Stations will be provided at Oshivelo and Ondangwa and the proposed location of these relative to future town developments, are indicated on Layout Plan No 81361/15 and 81361/16.

  At Tsumeb the present station has all required passenger and freight facilities and no additions are required.

- Ondangwa-Oshakati (Refer to Plan No. 81351/10 and 11)

  The powerline between Ondangwa and Oshakati is more than 8 kilometres away from MR 92 and it would serve no purpose to follow this route.

Ongwediva is situated about 8 kilometres south of Oshakati and to the northeast of MR 92. It is a town in its own right and a major growth centre in the north. The present commercial development and future residential planning of Ongwediva is to the northeast of MR 92.

The extent of existing and proposed future developments at Oshakati and Ongwediva is indicated on Plan No. 81361/17. The proposed position of a station at Ongwediva, as well as two alternative positions at Oshakati, respectively to the west and east of DR 3620 to Okatana, are also shown on this drawing.

The alternative station location west of DR 3620 is closer to the present economic centre of Oshakati, but is located in a low area and will require extensive foundation work and stormwater drainage. A road over rail bridge for DR 3620 will be required.

The alternative station location east of DR 3620 is farther away from the economic centre, but is located on higher laying ground and no road over rail bridge is required. This location is the recommended option.

To the north of Ondangwa, TR1/11 will cross the rail line by means of a road over rail bridge. The railway then diverts to the north around Ondangwa Airport where a siding will be provided to access the planned industrial area east of the airport.

The length of the main runway at Ondangwa Airport is 3 000 m which is adequate to accommodate a Boeing 747 aircraft with certain limitations. It is not foreseen that there will be a need to extend the runway in the future. However, if that should happen, the rail line can be shifted farther north.

West of the Ondangwa Airport it is proposed that the rail line follow MR 92, some 200 to 400 m to the northeast of the road.

Oshanas draining stormwater from Angola in the north and towards the Etosha Pans in the south, cross the rail line in the Ongwediva-Oshakati area and four river bridges are required.

- Ondangwa – Oshikango (Refer to Plan No. 81361/10 and 12 through 14)

  In principle there is little to choose between placing the rail line to the west or east of TR1/11 between Ondangwa and Oshikango.

  A water pipeline runs parallel and to the east of the road and has attracted people to settle on that side of the road. If stations are needed to serve the local population in the future, less people would need to cross the highway if the rail line is placed to the east of the road.

  Plan No's 81361/10,12,13 and 14 show alternate alignments between Ondangwa and Oshikango, one on the east and the other on the west side of TR1/11. The alignment east of TR1/11 will require a road over rail bridge at the crossing of MR 110, which would be avoided by the line being located west of TR1/11. The east option has the advantage of providing a future border crossing within walking distance (300m) of the customs and immigration post, should be line eventually be extended into Angola. The westerly option would provide access to the EPZ without a siding crossing TR1/11. Also there appears to be more commercial development on the west side of TR1/11.

  On balance the alignment west of TR1/11 appears to be preferable.

  The alternate track alignments within Oshikango are shown on Plan No. 81361/18.

  It became apparent early in the study that the route alignment must be within a narrow corridor generally following TR1/10, TR1/11 and MR 92. Ondangwa, Oshakati and Oshikango are located on these roads and obviously must be served. Oshivelo and numerous smaller communities, as well as most of the commercial developments are also near these routes. For these reasons, alignment selection was primarily a process of determining how close, and on which side of the roads the railway should be located and where stations should be located in the larger communities. Under these circumstances no detailed matrix or mathematical weighting was called for.

5.3 DESCRIPTION OF CORRIDOR

5.3.1 Geology

With the exception of the first 25 kilometres to the north and west of Tsumeb, which is underlain by dolomite, limestone, shale and chert of the Tsumeb Subgroup, the entire route is underlain by sand, and pedogenic of the Kalahari Group.

The first 25 kilometres to the north and west of Tsumeb is the only section of the route where outcrops and sub-outcrops of bedrock occur or where bedrock will be encountered within 5 m of the surface.

The dolomitic and chert and limestone occurrences within the sequence of the Tsumeb Subgroup rocks should be investigated for potential sources of ballast. Areas, which are underlain by rocks of the Tsumeb Group, are characterised by a relatively thin soil cover, which is seldom more than 2 m thick. Calcrete or surface limestone is common in these generally sandy gravely soils. The calcrete tends to occur as nodules, large slab-like boulders and as hard pan medium hard rock pedogenic surface and subsurface deposits.

Further north towards Oshivelo the thickness of the Kalahari Group sand and pedogenic deposits which overlay the rocks of the Tsumeb Subgroup rocks, increases rapidly and in the area of Oshivelo as well as Ondangwa, it is well over 200 m thick.

The Kalahari Group sands are reddish to yellowish in colour and in the areas of drainage paths they tend to be silty and are more brownish in colour. The sands are of mixed fluvial and aeolian origin. To about 24 kilometres north of Oshivelo the surface sands of the Kalahari Group contain calcrete deposits of pedogenic origin. Along this section of the route the calcrete deposits are characterised by approximately 2 m thick hard pan layers which can extend over considerable areas. Nodular and boulder calcrete deposits also occur however.

Between Oshivelo and Ondangwa the hardpan deposits in the Kalahari sands are less common. Deposits of nodular and powdery calcrete do however occur. The frequency of hardpan calcrete occurrences tends to decrease in a north-westerly direction.

5.3.2 Terrain

The general terrain characteristics along the route are as follows:

- Tsumeb to Oshivelo

  Flat to rolling with mountain outcrops at Tsumeb.

  Bushy terrain with large trees.

  Omuramba Owambo, a river south of Oshivelo

- Oshivelo to Ondangwa, Oshakati and Oshikango

  Extremely flat terrain with shallow courses (oshanas) and pans

  Defined watercourses restricted to one at Oshivelo, two south of Ongwediva and two at Oshakati

  Remainder of route has no defined watercourses and drainage will be important to distribute water on both sides of the rail.

5.3.3 Land use

Land use and water availability in the study area is generally as noted below:

- Tsumeb to Oshivelo

  Commercial farmland which will probably require fencing.

  Fresh water available from boreholes on farms and at Otjikoto Lake north of Tsumeb.

- Oshivelo to Ondangwa
- Ondangwa to Oshakati
- Ondangwa to Oshikango

  Communal land – subsistence farming.

  Traditionally no fencing.

  Namwater pipeline from Oshakati to about 30 km north of Oshivelo and from Ondangwa to Oshikango provides for both human and animal consumption.

  Boreholes with fresh water at Oshivelo and various places along the route. Boreholes at Andoni flats mostly brackish but suitable for layerwork construction. (Plan from Department of Water Affairs indicating position and capacity of boreholes to be included in Final Report).

  Hot springs with brakish water next to the road at Okaskana (Rössing Foundation), about 65 km north of Oshivelo.

  Semi-purified water available at Ondangwa and Oshakati.

  Oshanas retain water during rainy season and later in the year depending on rainfall.

5.4 DESIGN STANDARDS

5.4.1 Review of Current Standards

A review was made of design standards used by NamRail for new construction. Also, the Consultant included some specifications that were thought to be appropriate for the proposed Northern Railway Extension. A summary of the most important design standards used is shown in Table 5.1.

TABLE 5.1
DESIGN STANDARDS

ITEM	STANDARD
GENERAL	
• Gauge	1 065 m
• Number of main tracks	1 track
• Maximum grade	1:66
• Maximum axle loading	18.5 tonnes
• Maximum design speed	100 kph
• Siding length	600 m
• Right of way width	40 m generally, wider at stations as required
GEOMETRY	
• Curvature	Horizontal 800 m minimum Vertical 5 000 m minimum
• Cant	40 mm maximum 16 mm deficiency
• Turnouts	1:12 main line 1:9 sidings and yards
TRACK STRUCTURE	
• Rail	Main line: 48 kg or heavier No. 1 relayer or new Sidings: 30 kg or heavier (bolted) No. 1 relayer All rail to be continuously welded
• Sleepers	Generally : Concrete monoblock laid at 700 mm centres. Turnouts: Lengths and spacings as shown on NamRail standard turnout drawings 1:12 Concrete 1:9 Rail substitute
• Fastenings	Pandrol or Fist
• Ballast	Crushed stone to NamRail specifications 1 250 m^3 per km (see Appendix 5.1)
CLEARANCES	
• Minimum track centres	Main line to siding 6 m Siding to siding 4 m
• Minimum clearance to structures	Vertical : 5,0 m from top of rail Horizontal: 3,0 m from centre line of track
BRIDGES AND CULVERTS	
• Capacity	18.5 ton axle loading
• Construction	Reinforced or Pre-stressed, Prefabricated or built in-situ concrete

Other more specific design criteria proposed are as follows:

- Cattle guard

  NamRail's standard cattle guard design will be used at fence lines in commercial farming areas. The design is shown in Plan No. 81361/21.

- Road Crossings

  The NamRail standard road crossing detail indicates that the opening between rails shall be filled with level crossing concrete blocks. This detail will be retained for crossings with low traffic volumes, i.e. farm roads. For district roads with higher traffic volumes, the concrete blocks will be replaced by steel guardrails inside of the running rails with a 100 mm thick asphalt layer applied between the guard-rails.

- Crossings of water pipelines

  Since NamRail has no standard detail for crossing water pipelines, the matter was taken up with Namwater. Where the railroad crosses water pipes, provision shall be made to protect these as follows:

  - Pipes less than 300 m in diameter.

    Place split concrete pipes around the water pipe. The diameter of the split pipe shall be equal to the diameter of water pipe plus 200 mm. Close ends of the concrete pipe by means of brickwork.

  - Pipes larger than 300 mm in diameter.

    Build Namwater standard size 1,2 m * 1,2 m services culvert over the pipe and close ends by means of brickwork.

  It is estimated that 5 split concrete pipes and 5 service culverts will be required at crossings with respectively Namwater and Water Affairs pipelines and these costs have been included in the project cost estimates.

- Powerline and phone line crossings

  According to Government Gazette No. 1617 of 1 August 1997, the minimum height of electric conductors above the top of the rail shall be 6,1 m at all railway crossings. Nampower's specification requires a clearance between the top of rail and a 132 kVA conductor, of 7,5 m. The rail crossing shall be as near as possible to a right angle with the powerline and a minimum of 45 m from power poles.

  To achieve these requirements, it may be necessary to install additional power poles where the rail line crosses 132 kVA or 11kVA lines and provision has been made for these in the cost estimates.

- Fencing
  Where required, fences will be provided next to the rail line in accordance with the Department of Transport's standard details (see Plan No 81361/23).

- Culverts

  For drainage purposes, concrete portal rectangular culverts, SATS Type Class 1 Loading, will be used, varying in size from 750*450 to 1 800 * 900.

  The railway follows existing roads and the culverts underneath these roads have been taken as the basis to calculate the drainage requirements underneath the rail line. Typical culvert details are shown in Plan No 81361/24.

- Bridges

  Concrete bridges will be designed on a site specific basis during the detail design stage at six localities checked against existing bridges underneath the adjacent main roads.

- Formation Design

  The formation design is based on the SATS: Geotechnical Services Handbook, Section 4. The design philosophy for the pavement is based on a layered system approach because trainloads are transferred from the steel wheel via the track components and the ballast to the formation and bulk earthworks.

  A N2 line classification was used based on the following information:

  - Rail mass 48 kg/m
  - Sleeper Type Concrete Mono Block
  - Sleeper Spacing 700 mm
  - Max speed 100 km/h
  - Max axle load loco 18.5 tonnes
  - Max axle load wagon 18.5 tonnes

  For a N2 line classification and a dry climate region, the following formation is recommended according to SATS design catalogue:

  - 200 mm thick ballast
  - 200 mm thick sub-ballast type SB compacted to 95% of Modified AASHTO density. Min CBR is 20 at 95% of Modified AASHTO density.
  - 150 mm thick A-layer compacted to 95% of Modified AASHTO density. Min. CBR is 15 at 95% of Modified AASHTO density.
  - 300 mm thick B-layer compacted to 93% of Modified AASHTO density. Min. CBR is 10 at 93% of Modified AASHTO density.
  - Bulk earthworks/In situ material. Compacted to 90% of Modified AASHTO density. Min. CBR is 3 at 90% of Modified AASHTO density.

  Where the in situ layers satisfy the layer standards for the layers beneath sub ballast, these layers need not be constructed.

- Cross Section

  A typical cross section of the track subgrade and structure is shown in Plan No 81361/20.

- Ballast Stone

  NamRail has ballast stone specification for rail lines. A copy of this specification is attached as Addendum 5.1.

5.4.2 Proposed Livestock Protection

- Fencing
  - Tsumeb to Oshivelo

    For this section the rail line traverses commercial farmland. Farm boundaries, as well as camps within these farms are provided with stock proof fences to restrict the movement of large herds of cattle, which are normally unattended. It is proposed that the rail line be fenced in this area. Cattle crossings need to be limited to locations where farm roads cross the line. At these locations cattle guards will be provided.

    Where the rail line is in close proximity to a water point, cattle crossings may be required.

    Lateral pipes will be installed across the rail line at existing watering points to provide water on both sides of the track and reduce crossing by livestock.

During the detail design stage the requirements at each farm will be taken into account and the required facilities provided in consultation with the owners.

- Oshivelo to Ondangwa, Oshakati and Oshikango

  On these line segments the rail line traverses communal land, which is traditionally not fenced. Smaller herds of cattle wander the open plains and each herd is normally attended to by a member of the owner's family.

  The main source of water is at watering points along the water pipeline running parallel to TR1/11. Cattle, therefore, will need to cross the proposed rail line at regular intervals.

  None of the Main or Trunk Roads in the northern regions, nor the water canal to Oshakati, are fenced at present. Fences initially installed have been taken down by the local population to obtain easy access to these facilities. The most recently constructed canal (Ogongo – Oshakati) was never fenced.

  It is not proposed to fence the rail line in the communal area but to provide cattle crossings at regular intervals. By providing these cattle crossings as described in the following paragraph, at strategic points, maintenance to the rail line as a result of uncontrolled cattle crossings, could be minimised.

- Cattle crossing

  The proposed cattle crossing is detailed on Plan No. 81361/22. By flattening the side slope of the rail embankment to 1:10, easier access is provided for people and animals across the rail line. By extending the ballast stone onto the side slope, erosion of the stone underneath the track structure is minimised.

  By placing these cattle crossings at strategic points, i.e. waterpoints, villages, and homesteads, etc. they can be used with minimal inconvenience to herders and livestock. These points will be identified in close consultation with the community.

5.5 NATURAL MATERIAL SOURCES

5.5.1 Water

- Tsumeb to Oshivelo

  Sufficient water for construction and human consumption is available from boreholes on commercial farms and at the Otjikoto Lake.

  It should be noted that no water may be taken from a borehole, well or artificial dam without the consent of the owner. The Ministry of Finance – Treasury, from time to time, in terms of Section 17 of the State Finance Act, 1991, determines a reasonable tariff for the supply of water for the construction of roads. This tariff may serve as a guideline for the cost of water to construct the rail line.

- Oshivelo to Oshakati and Oshikango

  With the necessary permission from Namwater, water for human consumption is available from the water pipeline next to the road.

  As stated in paragraph 5.2.3, water for construction purposes may be obtained from hot springs at the Okashana (Rössing Foundation), semi-purified water at Ondangwa and Oshakati, Oshanas and boreholes. To extract water from boreholes permission must first be obtained from the Department of Water Affairs.

  Sufficient water should be available for the construction of the railway. Depending on how much it rains and the availability of boreholes, it may be necessary to transport water over

longer distances from July to December when water has dried up in oshanas. In any event, water supply must be considered in detail during the design stage.

5.5.2 Material for Layerwork

The rail line follows the existing network along TR1/10, TR1/11 and MR 92. The geological report (Section 5.3.1) indicates that there are good deposits of quality material between Tsumeb and Oshivelo. No difficulties are foreseen in finding suitable material in this area.

A borrow pit investigation has recently been done for the rehabilitation of TR1/11 between Oshivelo and Ondangwa and MR 92 between Ondangwa and Oshakati. TR1/11 between Ondangwa and Oshikango was constructed between 1983 – 85 and borrow pit information sheets on this route are available.

The borrow pit information indicates that there should be adequate material available along the route for the construction of the railway. West of Ondangwa towards Oshakati material will, however, become more scarce.

Borrow pits, especially those for sub ballast, will not necessarily be close to the rail line and provisions will be needed to haul material. Overburden of 2 m and more is general in this area.

5.5.3 Aggregate for concrete

Aggregates at the two existing crushers at Tsumeb have been tested on a regular basis in the past for various contracts and comply with SABS 1083 standards for concrete aggregate.

Similarly, a concrete aggregate source is available at Ruacana, some 200 km west of Oshakati.

5.5.4 Ballast Stone

The most economical choice would be to obtain ballast stone at Tsumeb, either from one or both of the existing quarries or by opening a new source. The reason being that Tsumeb is at the beginning of the project and the new rail line could then be used to transport the ballast stone along the route.

A sample of dolomitic stone from Henning Crushers at Tsumeb, has been tested and the results are attached as Appendix 5.2. According to these results the material complies with the specifications of NamRail for ballast stone.

The road between Oshivelo and Oshakati is at present being rehabilitated and various tests have been conducted on stone from respectively Ruacana (200 km west of Oshakati) and Tsumeb. Aggregate crushing values indicate that the stone from Ruacana is more durable than the Tsumeb stone. The cost premium of transporting stone from Ruacana by road needs to be taken into account when the quality of the stone from the two sources is compared.

The availability of ballast stone in the Tsumeb area plays an important role in the economic viability of the project. It is recommended that a detailed material investigation be conducted in the Tsumeb area and, if required, at Ruacana to confirm the availability of quality materials.

It is obviously preferable from a cost standpoint to have the ballast source as close as possible, it is also desirable to be able to transport the ballast by rail to avoid the truck traffic and wear on the roads.

For the purpose of the cost estimate for this study, it was assumed that the ballast stone from Tsumeb will conform to the required standards and be used.

5.6 PROPOSED CONSTRUCTION TECHNIQUES

- Locally Manufactured Products

Most consumer products in the northern regions are imported via Windhoek or Walvis Bay with little merchandise being transported to the south. Because road transport is not economically utilised in both directions, transport tariffs from Windhoek to the north are expensive. Local production of goods should therefore be encouraged (even at a small premium) to ensure that the local community receives the benefits.

In total over 350,000 sleepers and 821 rectangular culverts will be required for the proposed project. To manufacture the sleepers, 75,000 ton or 31,000 m^3 of concrete will be used. Similarly for the culverts 4,500 ton or 1,800 m^3 of concrete will be required.

Adequate sources for concrete stone are available in the Tsumeb area, as well as industrial plots with infrastructure such as rail facilities for bulk cement transport, power supply and water.

Two manufacturing firms have investigated the opportunity and found it viable to establish culvert and sleeper manufacturing plants in Tsumeb.

Manufacturing the concrete culverts and sleepers will be a labour intensive process and a minimum of 100 new work opportunities will be created over a period of two years.

It should be specified in the Tender Documents that sleepers and culverts be manufactured at Tsumeb and that local workers be employed.

- Labour Based Construction Methods

All construction vehicles, plant and equipment are imported into Namibia. In general, suppliers keep small stocks of spare parts available in Windhoek, but this is not the case in the northern regions. Similarly, specialised maintenance personnel are not readily available in the north. Operating and maintaining construction machinery on this project will therefore be expensive.

On the other hand, there is a large untapped labour force available in the Four O Regions. By specifying labour based construction methods in the tender documents, the opportunity exists to use the inexpensive labour market and provide work opportunities to local people.

Because enough high quality formation material is not located along the line, some will have to be trucked in from a distance. However, it is proposed that the first two layers of subgrade be done with labour based construction methods. This will create about 380 jobs for unskilled workers over the 22 month construction period.

It is, however, important that labour-based tasks be chosen selectively and on a competitive basis with machine based construction methods to maintain the economic viability of the project.

It is proposed that the following tasks be reserved in the tender documents for labour-based construction methods:

- Clearing and grubbing
- Excavating and placing the first two layers of subgrade material
- Level crossing construction

- Installing culverts

- Construction of in-situ concrete floors and brick in- and outlet structures at 821 culverts, which will provide work for 200 people over a 22 month period.

- Most track construction including the placing of ballast on the road formation, final placing of sleepers into position and laying of rail on sleepers which will provide about 75 jobs for unskilled workers during the 24 month construction period.

The construction of buildings (in this case station buildings) and stockproof fencing are traditionally done mainly by hand labour and no specific provision needs to be made in the tender documentation for these.

Overall, an average of approximately 650 unskilled workers will be needed for the 30 month construction period. Appendix 5.3 shows the total estimated employment.

5.7 COMMUNICATIONS

As noted in Section 3.8 radio will be used for train control and telephonic equipment will be installed at stations to connect with the present NamRail communications network. The estimated equipment requirements and costs are shown in Table 5.2 for Phases 1, 2 and 3.

TABLE 5.2
COMMUNICATIONS EQUIPMENT

Item	Unit Cost	Phase 1		Phase 2		Phase 3	
		No	Cost N$	No	Cost N$	No	Cost N$
Radio Repeaters	50,000	4	200,000	1	50,000	1	50,000
Radio Base Stations	8,300	2	16,600	1	8,300	1	8,300
Mobile Radios	2,200	4	8,800	0	0	1	2,200
Radio Hand Sets	1,500	12	18,000	2	3,000	2	3,000
Telephone Equipment	LS		6,000		3,000		3,000
Computers	11,000	1	11,000	1		1	
TOTALS			**260,400**		**64,300**		**66,500**

5.8 MATERIAL SOURCES

The main materials required for the Northern Railway Extension are rail and fasteners, special trackwork (turnouts), concrete sleepers and concrete for structures. Requirements and sources are noted below:

- Rail and fasteners

Rail and fasteners will, of necessity, have to be imported. New rail of 48 kg/m weight is available from numerous manufacturers. Second hand rail can be obtained in North America and possibly other locations. The source selected will depend on availability and price when tenders are requested.

- Sleepers

  As previously mentioned, concrete sleepers will be manufactured on site with locally available materials.

- Concrete

  The cement and aggregates needed for concrete are locally available.

5.9 CONSTRUCTION COST

Table 5.3 provides a summary of infrastructure construction costs for Phase 1, Phase 2 and Phase 3. Details are shown in Appendix 5.4.

All prices used are in current Namibian dollars and no allowance has been made for inflation between the present time and the actual start of construction.

TABLE 5.3

SUMMARY OF INFRASTRUCTURE CONSTRUCTION COST

DESCRIPTION	ESTIMATED COST			
	PHASE 1: TSUMEB TO ONDANGWA	PHASE 2: ONDANGWA TO OSHAKATI	PHASE 3 : ONDANGWA TO OSHIKANGO	ALL PHASES
	COST (N$)	COST (N$)	COST (N$)	TOTAL (N$)
Land Acquisition	5,180,000	2,000,000	3,000,000	10,180,000
Contractor's Establishment	10,982,857	1,771,429	2,745,714	15,500,000
Clearing and Grubbing	1,150,720	185,600	287,680	1,624,000
Earth work (fill, sub-ballast and ballast)	43,510,732	7,017,860	10,877,683	61,406,275
Trackwork (sleepers and rail)	179,315,381	28,921,856	44,828,740	253,065,978
Structures (culverts, bridges and power line towers)	19,512,453	7,508,971	2,712,924	29,734,347
Stations, Platforms and Buildings	6,663,389	2,873,006	1,745,662	11,282,057
Roadwork (access roads)	500,000	100,000	100,000	700,000
Communications	260,400	64,300	66,500	391,200
Project management, Design and Site Supervision	12,754,286	2,057,143	3,188,571	18,000,000
TOTALS	**279,830,218**	**52,500,164**	**69,553,475**	**401,883,857**

6. CAPITAL COST ESTIMATES

6.1 INFRASTRUCTURE

The infrastructure required for the proposed Northern Railway Extension has been denoted in Section 5. The costs for the various elements involved are divided into main categories, which are:

- Land acquisition
- Clearing and grubbing
- Earthwork
- Trackwork
- Structures
- Stations and support facilities
- Roads, crossings and fences
- Communications
- Environmental assessment and design
- Project Management
- Contractor's establishment

These costs are broken down by the 3 construction phases and summarised in Tables 6.1 and 6.2.

TABLE 6.1
INFRASTRUCTURE COSTS
PHASE 1
TSUMEB TO ONDANGWA

COST CATEGORY	YEAR OF EXPENDITURE	COST (N$)
Land Acquisition	Year 1-2-3	5,180,000
Clearing and Grubbing	Year 1-2-3	1,150,700
Earthwork	Year 1-2-3	24,755,700
Trackwork	Year 1-2-3	198,070,300
Structures	Year 1-2-3	18,226,100
Stations and Support Facilities	Year 1-2-3	6,663,400
Roads, Crossings and Fences	Year 1-2-3	1,786,400
Communications	Year 3	260,400
Contractor's Establishment	Year 1-2	10,983,000
Design, EA and Project Management	Year 1-2-3	12,754,300
TOTALS		**279,830,300**

TABLE 6.2
INFRASTRUCTURE COSTS
PHASES 2 AND 3
ONDANGWA - OSHAKATI/OSHIKANGO

COST CATEGORY	ONDANGWA - OSHAKATI (N$)	ONDANGWA - OSHIKANGO (N$)
Land Acquisition	2,000,000	3,000,000
Clearing and Grubbing	348,000	417,600
Earthwork	4,991,100	5,970,000
Trackwork	33,832,700	40,598,200
Structures	7,088,000	2,436,300
Stations and Support Facilities	2,873,000	1,700,700
Roads, Crossings and Fences	461,000	373,000
Communications	64,300	66,500
Design, EA and Project Management	6,857,100	8,228,600
TOTALS	58,515,200	62,790,900

6.2 ROLLING STOCK

As was discussed in Section 3.4, the locomotives now on the NamRail roster should be sufficient to handle the traffic levels forecast for both Scenarios 1 and 2. However, for the requirements of Scenario 2, three locomotives now stored should be re-activated. These locomotives were stored in serviceable conditions so there should be no significant expense involved in re-activating them.

With respect to freight wagons, at the traffic levels forecast for Scenario 2, it is estimated that twenty additional container flats will be needed. It is proposed that these be converted from stored cattle wagons and the expense for doing this has been estimated and included in the total project cost.

For Scenario 1 traffic levels, no additional containers will be required. However, under the traffic assumptions of Scenario 2, it is estimated that twenty 6m "Pallet friendly" containers and twenty 3m insulated tank containers should be acquired or, preferably, built by NamRail forces at the Windhoek workshop.

Rolling stock costs are summarised in Table 6.3

TABLE 6.3
SCENARIO 2
ROLLING STOCKS COSTS

CATEGORY	UNITS	UNIT COST (N$)	TOTAL COSTS (N$)
Rehabilitate locomotives	0	0	0
Convert cattle wagons to container flats	20	150,000	3,000,000
Acquire 6 m "Pallet Friendly" containers	20	47,000	940,000
Acquire 3 m insulated tank containers	20	37,000	740,000
TOTAL			4,680,000

6.3 CONSTRUCTION EQUIPMENT FOR TRACKWORK

The major construction equipment required for this project includes:

Rail equipment

1 – 11 wagon welded rail train to carry 144 m rails

1 – 12 wagon sleeper train

1 – 40 wagon ballast train

1 – Production Tamper

1 – Ballast regulator/broom

NamRail will make available the locomotives and wagons for construction trains but the costs of train operation and crews have been included in track construction costs.

NamRail will also make available a tamper and ballast regulator for the construction period but again the cost of tamping and dressing track has been included in the track construction category in Section 5.

Mobile Equipment

4 – 10 ton boom trucks

4 – 5 ton lorries

1 – D6 dozer or equivalent

3 – Air compressors and attachments

This equipment will all be used for track laying and the costs have been included in this category in Section 5.

6.4 CONTAINER HANDLING EQUIPMENT

Ondangwa will require additional equipment, although it may be possible to transfer some from Tsumeb. Table 6.4 lists the equipment that would be provided and estimated costs.

TABLE 6.4
CONTAINER HANDLING EQUIPMENT
ONDANGWA CONTAINER DEPOT

ITEM	NUMBER	UNIT COSTS (N$)	TOTAL COSTS (N$)
Overhead Crane	1	1,500,000	1,500,000
4 ton Forklift	1	220,000	220,000
15 ton Forklift	1	800,000	800,000
Shunter Tractor	1	250,000	250,000
Semis for 12 m Containers	4	200,000	800,000
TOTAL			3,570,000

6.5 EMPLOYEE RELOCATION

Personnel who are transferred from Tsumeb or possibly other locations will be entitled to relocation expenses which should be considered part of the capital costs of the project. It is estimated that 20 employees will be transferred at a total cost of N$260,000.

6.6 ENVIRONMENTAL MITIGATION

This project will require not significant environmental procedures other than normal concerns involved for any major construction in this area. These include:

- Dust suppression
- Minimising construction roads and controlling vehicle movements to minimise traffic congestion and environmental damage
- Maintenance of sanitary and orderly work sites and temporary camps
- Provision of sedimentation ponds when required to prevent siltation
- Proper clean up of work sites and camps following completion of work
- Mosquito control as required.

None of these items require a major expenditure and costs have been incorporated into the various line items shown in the estimates.

6.7 SUMMARY OF COST ESTIMATES

The capital costs for Phase 1 are summarised in Table 6.5.

TABLE 6.5
SUMMARY OF CAPITAL COSTS
PHASE 1

COST CATEGORY	SCENARIO 1 (N$)	SCENARIO 2 (N$)
Infrastructure	279,830,300	279,830,300
Rolling Stock	0	4,680,000
Container Handling Equipment	3,570,000	3,570,000
Employee Relocation	260,000	260,000
TOTALS	**283,660,300**	**288,340,300**

The capital costs for Phases 2 and 3 are summarised in Table 6.6.

TABLE 6.6
SUMMARY OF CAPITAL COSTS
PHASES 2 AND 3

COST CATEGORY	PHASE 2 (N$)	PHASE 3 (N$)
Infrastructure	58,515,200	62,790,900
Rolling Stock	0	0
Container Handling equipment	0	0
TOTALS	**58,515,200**	**62,790,900**

7. OPERATING AND MAINTENANCE EXPENSE

7.1 TRAIN OPERATING AND MAINTENANCE EXPENSE

Train operating expenses are based on the proposed train frequencies and schedules described in Section 3. Labor costs are based on the use of a driver and assistant on each train and a passenger attendant when required. Locomotive and car running expenses are based on current NamRail costs supplemented by the Consultants estimates as needed.

Table 7.1 shows the unit costs used to calculate the train-related expenses.

TABLE 7.1
OPERATING AND MAINTENANCE UNIT COSTS

FUNCTION	COSTS (N$/km)
Locomotive Operations	10.75
Freight Wagon Maintenance	0.16
Passenger Coach Maintenance	1.00

The train crew salaries used to compute labor costs are shown in Table 7.2. All working conditions – hours and days worked, overtime payments, etc. – are based on current practices.

TABLE 7.2
TRAIN CREW SALARIES

CLASSIFICATION	ANNUAL SALARY (N$)
Driver	76,259
Assistant Driver	55,322
Passenger Attendant	50,392

Note: Salaries include all benefits, allowances and overheads

Train operating and maintenance expenses for Scenario 1 are shown in Table 7.3 and increased crew expense in Table 7.4. These figures are incremental costs that would be incurred if the forecast traffic increases take place. Similar costs for Scenario 2 are denoted in Tables 7.5 and 7.6.

Table 7.7 shows the increased hire charge expense that will be paid to Spoornet for rental of wagons and containers. These costs are based on the assumption that all new traffic originating in the RSA will move in Spoornet wagons and containers.

TABLE 7.3
ADDITIONAL TRAIN OPERATIONAL AND MAINTENANCE EXPENSE
SCENARIO 1

EXPENSE CATEGORY	KILOMETRES OPERATED ANNUALLY	COSTS (N$)
LOCOMOTIVE		
Upington - Windhoek	0	0
Windhoek - Otjiwarongo	43,500	467,300
Walvis Bay - Otjiwarongo	336,100	3,612,800
Otjiwarongo - Tsumeb	47,600	511,500
Tsumeb - Ondangwa	155,400	1,670,300
Subtotals	582,600	6,261,900
FREIGHT WAGON		
Upington - Windhoek	1,295,700	207,300
Windhoek - Otjiwarongo	953,000	152,500
Walvis Bay - Otjiwarongo	543,400	86,900
Otjiwarongo - Tsumeb	655,100	104,800
Tsumeb - Ondangwa	2,193,700	351,000
Subtotals	5,640,900	902,500
PASSENGER COACHES	77,700	77,700
TOTALS		**7,242,100**

TABLE 7.4
ADDITIONAL CREW EXPENSE
SCENARIO 1

LINE SEGMENT	INCREASED TRAINS ANNUALLY	COSTS (N$)
Upington - Windhoek	0	0
Windhoek - Otjiwarongo	0	0
Walvis Bay - Otjiwarongo	0	0
Otjiwarongo - Tsumeb	0	0
Tsumeb - Ondangwa	624	418,400
TOTALS	**624**	**418,400**

TABLE 7.5
ADDITIONAL TRAIN OPERATIONAL AND MAINTENANCE EXPENSE
SCENARIO 2

EXPENSE CATEGORY	KILOMETRES OPERATED ANNUALLY	COST (N$)
LOCOMOTIVE		
Upington - Windhoek	221,400	2,380,200
Windhoek - Otjiwarongo	347,800	3,738,600
Walvis Bay - Otjiwarongo	336,100	3,612,800
Otjiwarongo - Tsumeb	47,600	511,500
Tsumeb - Ondangwa	310,800	3,340,600
Subtotals	1,263,700	13,583,700
FREIGHT WAGON		
Upington - Windhoek	4,525,000	724,000
Windhoek - Otjiwarongo	4,159,100	665,500
Walvis Bay - Otjiwarongo	1,228,100	196,500
Otjiwarongo - Tsumeb	2,500,200	400,000
Tsumeb - Ondangwa	5,088,100	814,100
Subtotals	17,500,500	2,800,100
PASSENGER COACHES	77,700	77,700
TOTALS		**16,461,500**

TABLE 7.6
ADDITIONAL CREW EXPENSE
SCENARIO 2

LINE SEGMENT	TRAINS INCREASE ANNUALLY	COST (N$)
Upington - Windhoek	0	0
Windhoek - Otjiwarongo	416	87,600
Walvis Bay - Otjiwarongo	0	0
Otjiwarongo - Tsumeb	104	43,800
Tsumeb - Ondangwa	832	549,900
TOTALS	**1,352**	**681,300**

TABLE 7.7
HIRE CHARGES EXPENSE

CATEGORY	UNIT COST (N$)	DAYS ANNUALLY	TOTAL COST (N$)
SCENARIO 1			
Freight Wagons	41.00	5,000	205,000
Containers	25.65	5,940	152,400
TOTALS			**357,400**
SCENARIO 2			
Freight Wagons	41.00	14,630	599,800
Containers	25.65	20,760	532,500
TOTALS			**1,132,300**

Note: See Appendix 7.1 for details of calculations

7.2 STATION OPERATING EXPENSE

For the proposed station at Ondangwa, operating expenses, excluding salaries were estimated using Tsumeb as a basis for the various costs categories.

There was assumed to be a net increase in positions and salaries for only 5 security personnel as other personnel would be transferred from Tsumeb or are already employed at Ondangwa.

At Oshivelo, only one 5 day per week clerical position would be needed and other station expenses would be small. Staff would, however, probably need to be increased if weekend express passsenger service would be inaugurated,

A summary of incremental station expenses is shown in Table 7.8.

TABLE 7.8
INCREMENTAL STATION EXPENSE

LOCATION	LABOUR	EQUIPMENT AND OTHER	TOTAL COST ANNUALLY (N$)
Ondangwa	133,000	350,000	483,000
Oshivelo	42,000	20,000	62,000
TOTALS	**175,000**	**370,000**	**545,000**

7.3 INFRASTRUCTURE MAINTENANCE EXPENSE

These costs were estimated based on information furnished by NamRail Permanent Way and Communications managers.

The line will have relatively light traffic and, in addition, will be new and have low maintenance features such as concrete bridges. As a result, maintenance expense, particularly in early years will be low.

Table 7.9 summarizes permanent way and communications maintenance expenses.

TABLE 7.9
SUMMARY
ANNUAL INFRASTRUCTURE MAINTENANCE EXPENSE
SCENARIOS 1 AND 2

CATEGORY	LABOUR (N$)	TRANSPORT (N$)	EQUIPMENT (N$)	TOTAL (N$)
TRACK				
Normal Maintenance	577,000	92,000	20,000	689,000
Tamping (10 year cycle)			85,000	85,000
Subtotal	577,000	92,000	105,000	774,000
COMMUNICATIONS	75,000		10,000	85,000
TOTALS	**652,000**	**92,000**	**115,000**	**859,000**

Table 7.10 summarises all off-line and extension operating and maintenance expense for both Scenarios 1 and 2.

TABLE 7.10
SUMMARY
ANNUAL INCREMENTAL OPERATING AND MAINTENANCE EXPENSE
SCENARIOS 1 AND 2

EXPENSE CATEGORY	SCENARIO 1 (N$)	SCENARIO 2 (N$)
Locomotive Operation	6,261,900	13,583,700
Wagon Operation	902,500	2,800,100
Coach Operation	77,700	77,700
Train Crews	418,400	681,300
Rolling Stock Hire	357,400	1,132,300
Station Operations	370,000	370,000
Station Staff	175,000	175,000
Infrastructure Maintenance Labour	652,000	652,000
Infrastructure Maintenance Material and Equipment	207,000	207,000
TOTALS	**9,421,900**	**19,679,100**

7.4 REDUCED TRUCKING COSTS

NamRail will reduce costs somewhat by transporting freight by rail, rather than by truck from the present rail head at Tsumeb to Ondangwa. However, the Consultant's analysis indicated that these savings are insignificant, because the reduced truck costs and revenues are mostly offset by increased rail costs and revenues.

7.5 OPERATING AND MAINTENANCE EXPENSE BEYOND ONDANGWA

Operating expenses that would be associated with Phase 2 (Ondangwa-Oshakati) and Phase 3 (Ondangwa-Oshikango) are shown in Table 7.11.

TABLE 7.11
ANNUAL OPERATING AND MAINTENANCE EXPENSE
PHASES 2 AND 3

Expense Category	Phase 2 (N$)	Phase 3 (N$)	Both (N$)
Locomotive Operations	234,800	402,500	637,300
Wagon Operations	12,600	7,200	19,800
Coach Operations	10,900	18,700	29,600
Train Crews	131,600	131,600	131,600
Station Operations	10,000	10,000	20,000
Station Staff	100,000	100,000	200,000
Infrastructure Maintenance	105,000	180,000	285,500
TOTALS	**604,900**	**850,000**	**1,323,300**

7.6 EXTENSION AND CURRENT NAMRAIL OPERATING COSTS

The unit operating and maintenance costs for the new line are considerably lower than current NamRail system costs. Mainly this is because extension expenses have been calculated on an incremental basis and are essentially only variable costs that do not include system fixed costs. The comparison and explanation are shown in Appendix 7.2.

8. FINANCIAL AND ECONOMIC EVALUATION

8.1 SUMMARY OF CAPITAL COSTS AND OPERATING EXPENSES

8.1.1 Capital Costs

Capital cost for construction of the three phases of the Northern Railway Extension were discussed in Section 6 of this report. These costs are summarised by general category in Table 8.1 for Phases 1,2 and 3.

TABLE 8.1
SCENARIO 2
SUMMARY OF CAPITAL COSTS

CATEGORY	PHASE 1 TSUMEB - ONDANGWA (N$)	PHASE 2 ONDANGWA - OSHAKATI (N$)	PHASE 3 ONDANGWA - OSHIKANGO (N$)	ENTIRE LINE (N$)
Infrastructure	279,830,300	52,500,200	69,553,500	401,883,900
Rolling Stock	4,680,000	0	0	4,680,000
Container Handling Equipment	3,570,000	0	0	3,570,000
Employee Relocation	260,000	0	0	260,000
TOTALS	**288,340,300**	**52,500,200**	**69,553,500**	**410,393,900**

Note: Scenario 1 costs have not been evaluated, because results are marginal.

A three year design mobilisation and construction period is planned for Phase 1, commencing with the date of Government approval. Phases 2 and 3 could be constructed in 7 and 9 months, respectively, if it is decided to progress with these extensions.

8.1.2 Operating and maintenance expense

Operating and maintenance expense was detailed in Section 7. These expenses have only been calculated for the line between Tsumeb and Ondangwa, as there does not appear to be a reasonable economic basis for initially extending the railway to either Oshakati or Oshikango.

A summary of operating and maintenance expense for both Scenarios 1 and 2 for the Tsumeb - Ondangwa segment is shown in Table 8.2.[1]

TABLE 8.2
SUMMARY OF ANNUAL OPERATING AND MAINTENANCE EXPENSE
TSUMEB TO ONDANGWA

EXPENSE CATEGORY	SCENARIO 1 (N$)	SCENARIO 2 (N$)
Train Operations	8,017,900	18,275,100
Infrastructure Maintenance	859,000	859,000
Station Expense	545,000	545,000
TOTALS	**9,421,900**	**19,679,100**

8.2 ESTIMATION OF REVENUE

8.2.1 General

With respect to passenger revenue, it is not a significant factor in the analysis of the line extension and has not been evaluated in detail.

In Section 2.4 of this report, forecasts were made of the freight traffic that could reasonably be captured following the opening of the Northern Railway Extension. These forecasts were based on two different sets of assumptions:

Scenario 1: In which rail pricing, service and marketing generally conform to the status quo.

Scenario 2: In which significant rate reductions are made, some aspects of service improved and a very aggressive marketing effort made.

In this section, freight revenues will be estimated. Generally the revenue calculations consider three factors:

1. Current NamRail rates for the commodities involved (see Appendix 8.1)
2. Current truck rates
3. Any discount in rail rates below truck rates required to compensate for transit time and/or service advantages of truck transport

There is one pending development that should be considered which is the implementation of a Road User Charge (RUC) system that will take place in the near future. In this study, the status quo has been assumed; i.e. no RUC charges applied to trucks, no resulting increase in truck costs and rates and therefore no costs benefits accruing to the railway. The RUC system will obviously increase truck costs and the overall effect will be beneficial to the railway to some extent. For the purposes of

[1] All operating data, costs and revenues shown in Sections 8.1 through 8.3 are for Base Year 1 of the financial and economic analyses that follow.

this study, however, it has been assumed that the railway will have to compete with the current truck rates.[2]

Revenues are based on distances to and from Ondangwa, as it would be the initial terminal for the Northern Railway Extension and a central location for the service area.

Revenues have been divided into those generated on the existing railway to Tsumeb and those charged for the additional transportation beyond Tsumeb to Ondangwa. This has been done to identify the incremental[3] revenue that will result if the Northern Railway Extension is built. In some cases, fuel for example, the incremental revenue would only be that for the Tsumeb-Ondangwa haul as the traffic already moves by rail from Walvis Bay to Tsumeb. For other commodities, such as fabricated metal products, the incremental revenue would be for the entire trip from Windhoek to Ondangwa as this would be new traffic for the railway because the product now moves entirely by truck.

The proposed rates and revenues generated for each scenario are now discussed:

Scenario 1

In the traffic analysis for Scenario 1, the main assumption was that the Northern Railway Extension would capture about 95% of the "base commodity" group with the same rate structure as is now in place. Again, with rates comparable to the present, only about 5% of the 'other commodity' group would be attracted to rail.

The commodities, origin and destination, distance hauled, tons, rate and total revenue for the goods that will be transported by rail are shown in Table 8.3. The total incremental revenue is estimated to be approximately N$ 18,8 million of which N$ 14,2 million would be generated by new rail traffic. Approximately N$ 4,6 million would be from existing traffic that could use the extension.

Scenario 2

In Scenario 2, the forecast traffic is considerably greater, because of rate reductions, service improvements and a concerted marketing effort. The 'base' traffic remains at 95% of the total market (some traffic will always move by truck , so a 100% market share is unrealistic), but the 'other' commodity group increases to an average of about 25% of the total market.

Table 8.4 tabulates the commodities, origin and destination, distance hauled, tons, rates and incremental revenue for Scenario 2. For this scenario, the incremental revenue would be approximately N$ 35,4 million. Again the largest component of the incremental revenue would be for new traffic estimated at N$ 30,8 million.

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[2] RUC charges are, however, considered in the economic analysis as an infrastructure cost.

[3] Incremental revenue for the extension is the component of incremental revenue attributable to the extension only and is calculated by multiplying the rate by the tonnage by the length of the extension. Incremental off-line revenue is the component of incremental revenue attributable to the extension, but which is carried on existing sections of the railway. It is calculated by multiplying the rate by the tonnage by the distance to/from the junction point of the extension.

TABLE 8.3
FORECAST ANNUAL RAIL TRAFFIC AND TOTAL INCREMENTAL REVENUE
SCENARIO 1

COMMODITY	ORIGIN	DEST.	DISTANCE - KMS			TONNAGE			RATE	REVENUE - EXISTING TRAFFIC			REVENUE - NEW TRAFFIC INCREMENTAL			TOTAL INC. REVENUE N$
			OFF-LINE	ON-EXT.	TOTAL	EXISTING	NEW	TOTAL	(N$/ton-km)	OFF-LINE	INC. ON-EXT.	TOTAL-EXISTING	OFF-LINE	ON-EXT.	TOTAL - NEW TRAFFIC	
										N$	N$	N$	N$	N$	N$	
Fuel	Walvisbay	Ondangwa	601	249	850	65,300	17,800	83,100	0.23	9,026,400	3,739,700	12,766,100	2,460,500	1,019,400	3,479,900	7,219,800
Cement	RSA	Ondangwa	2,083	249	2,332	25,000	0	25,000	0.14	7,290,500	871,500	8,162,000	0	0	0	871,500
	Otjiwarongo	Ondangwa	183	249	432	0	0	0	0.18	0	0	0	0	0	0	0
Scrap	Ondangwa	Windhoek	601	249	850	0	4,800	4,800	0.15	0	0	0	432,700	179,300	612,000	612,000
Lubricants	Walvisbay	Ondangwa	601	249	850	200	1,000	1,200	0.24	28,800	12,000	40,800	144,200	59,800	204,000	216,000
	Windhoek	Ondangwa	601	249	850	200	1,000	1,200	0.24	28,800	12,000	40,800	144,200	59,800	204,000	216,000
Aggregates	Tsumeb	Ondangwa	0	249	249	0	0	0	0.18	0	0	0	0	0	0	0
Bottles and packaging	RSA	Ondangwa	2,083	249	2,332	0	6,900	6,900	0.37	0	0	0	5,317,900	635,700	5,953,600	5,953,600
Maize meal	Windhoek	Ondangwa	601	249	850	0	0	0	0.20	0	0	0	0	0	0	0
	Otavi	Ondangwa	64	249	313	0	0	0	0.20	0	0	0	0	0	0	0
Bricks	Tsumeb	Ondangwa	0	249	249	0	0	0	0.20	0	0	0	0	0	0	0
	Windhoek	Ondangwa	601	249	850	0	3,200	3,200	0.20	0	0	0	384,600	159,400	544,000	544,000
Sugar	Windhoek	Ondangwa	601	249	850	0	2,500	2,500	0.14	0	0	0	211,900	87,800	299,700	299,700
	Otavi	Ondangwa	64	249	313	0	0	0	0.21	0	0	0	0	0	0	0
Bulk beer	Swakopmund	Ondangwa	553	249	802	0	0	0	0.58	0	0	0	0	0	0	0
Perishables	RSA	Ondangwa	2,083	249	2,332	0	1,100	1,100	0.31	0	0	0	710,300	84,900	795,200	795,200
Furniture	RSA	Ondangwa	2,083	249	2,332	0	400	400	0.37	0	0	0	308,300	36,900	345,200	345,200
	Windhoek	Ondangwa	601	249	850	0	300	300	0.41	0	0	0	73,900	30,600	104,500	104,500
	Walvisbay	Ondangwa	601	249	850	0	300	300	0.41	0	0	0	73,900	30,600	104,500	104,500
Packaged beer	Windhoek	Ondangwa	601	249	850	0	500	500	0.41	0	0	0	123,200	51,000	174,200	174,200
Other Beverages	Windhoek	Ondangwa	601	249	850	0	900	900	0.41	0	0	0	221,800	91,900	313,700	313,700
Steel	Windhoek	Ondangwa	601	249	850	0	300	300	0.26	0	0	0	48,900	19,400	68,300	68,300
Electric poles and equipment	Windhoek	Ondangwa	601	249	850	0	2,500	2,500	0.29	0	0	0	435,700	180,500	616,200	616,200
Cooking oil	Windhoek	Ondangwa	601	249	850	0	200	200	0.41	0	0	0	49,300	20,400	69,700	69,700
Groceries	Windhoek	Ondangwa	601	249	850	0	100	100	0.41	0	0	0	24,600	10,200	34,800	34,800
Fabricated metal products	Windhoek	Ondangwa	601	249	850	0	100	100	0.41	0	0	0	24,600	10,200	34,800	34,800
Fertilizers	Windhoek	Ondangwa	601	249	850	0	100	100	0.32	0	0	0	19,200	8,000	27,200	27,200
Liquor	Windhoek	Ondangwa	601	249	850	0	100	100	0.41	0	0	0	24,600	10,200	34,800	34,800
Timber	Windhoek	Ondangwa	601	249	850	0	0	0	0.29	0	0	0	0	0	0	0
Hardware and electrical products	Windhoek	Ondangwa	601	249	850	0	100	100	0.41	0	0	0	24,600	10,200	34,800	34,800
Roofing sheets	Windhoek	Ondangwa	601	249	850	0	100	100	0.29	0	0	0	17,400	7,200	24,600	24,600
Machines and vehicles	Windhoek	Ondangwa	601	249	858	0	0	0	1.32	0	0	0	0	0		0
Mixed containerized freight	Walvisbay	Ondangwa	601	249	850	0	500	500	0.22	0	0	0	66,100	27,400	93,500	93,500
TOTALS						90,700	44,800	135,500		16,374,500	4,635,200	21,009,700	11,340,400	2,830,800	14,171,200	18,806,400

TABLE 8.4
FORECAST RAIL TRAFFIC AND TOTAL INCREMENTAL REVENUE
SCENARIO 2

COMMODITY	ORIGIN	DEST.	DISTANCE - KMS			TONNAGE			RATE	REVENUE - EXISTING TRAFFIC			REVENUE - NEW TRAFFIC INCREMENTAL			TOTAL INC. REVENUE N$
			OFF-LINE	ON-EXT.	TOTAL	EXISTING	NEW	TOTAL	(N$/ton-km)	OFF-LINE N$	INC. ON-EXT. N$	TOTAL-EXISTING N$	OFF-LINE N$	ON-EXT. N$	TOTAL - NEW TRAFFIC N$	
;el	Walvisbay	Ondangwa	601	249	850	65,300	17,800	83,100	0.23	9,026,400	3,739,700	12,766,100	2,460,500	1,019,400	3,479,900	7,219,600
ement	RSA	Ondangwa	2,083	249	2,332	25,000	0	25,000	0.14	7,290,500	871,500	8,162,000	0	0	0	671,500
	Otjiwarongo	Ondangwa	183	249	432	0	10,000	10,000	0.15	0	0	0	274,500	373,500	648,000	648,000
crap	Ondangwa	Windhoek	601	249	850	0	4,800	4,800	0.15	0	0	0	432,700	179,300	612,000	612,000
ubricants	Walvisbay	Ondangwa	601	249	850	0	1,200	1,200	0.24	0	0	0	173,100	71,700	244,800	244,800
	Windhoek	Ondangwa	601	249	850	200	1,000	1,200	0.24	28,800	12,000	40,800	144,200	59,800	204,000	216,000
ggregates	Tsumeb	Ondangwa	0	249	249	200	14,200	14,400	0.16	0	8,000	8,000	0	565,700	565,700	573,700
ottles and ackaging	RSA	Ondangwa	2,083	249	2,332	0	27,600	27,600	0.15	0	0	0	8,623,600	1,030,900	9,654,500	9,654,500
laize meal	Windhoek	Ondangwa	601	249	850	0	18,000	18,000	0.18	0	0	0	1,947,200	806,800	2,754,000	2,754,000
	Otavi	Ondangwa	64	249	313	0	7,000	7,000	0.18	0	0	0	80,600	313,700	394,300	394,300
ricks	Tsumeb	Ondangwa	0	249	249	0	3,000	3,000	0.18	0	0	0	0	134,500	134,500	134,500
	Windhoek	Ondangwa	601	249	850	0	16,000	16,000	0.18	0	0	0	1,730,800	717,100	2,448,000	2,448,000
ugar	Windhoek	Ondangwa	601	249	850	0	8,000	8,000	0.19	0	0	0	913,500	378,500	1,292,000	1,292,000
	Otavi	Ondangwa	64	249	313	0	2,000	2,000	0.19	0	0	0	24,300	94,600	118,900	118,900
ulk beer	Swakopmund	Ondangwa	553	249	802	0	7,900	7,900	0.30	0	0	0	1,310,800	590,100	1,900,700	1,900,700
erishables	RSA	Ondangwa	2,083	249	2,332	0	2,300	2,300	0.29	0	0	0	1,389,400	166,100	1,555,500	1,555,500
urniture	RSA	Ondangwa	2,083	249	2,332	0	1,200	1,200	0.35	0	0	0	874,900	104,600	979,500	979,500
	Windhoek	Ondangwa	601	249	850	0	900	900	0.35	0	0	0	189,300	78,400	267,700	267,700
	Walvisbay	Ondangwa	601	249	850	0	900	900	0.35	0	0	0	189,300	78,400	267,700	267,700
ackaged beer	Windhoek	Ondangwa	601	249	850	0	3,000	3,000	0.18	0	0	0	324,500	134,500	459,000	459,000
Other everages	Windhoek	Ondangwa	601	249	850	0	2,700	2,700	0.18	0	0	0	292,100	121,000	413,100	413,100
Steel	Windhoek	Ondangwa	601	249	850	0	1,800	1,800	0.20	0	0	0	216,400	89,600	306,000	306,000
Electric poles and equipment	Windhoek	Ondangwa	601	249	850	0	3,500	3,500	0.22	0	0	0	462,800	191,700	654,500	654,500
Cooking oil	Windhoek	Ondangwa	601	249	850	0	1,000	1,000	0.18	0	0	0	108,200	44,800	153,000	153,000
Groceries	Windhoek	Ondangwa	601	249	850	0	600	600	0.18	0	0	0	64,900	26,900	91,800	91,800
Fabricated metal products	Windhoek	Ondangwa	601	249	850	0	300	300	0.30	0	0	0	54,100	22,400	76,500	76,500
Fertilizers	Windhoek	Ondangwa	601	249	850	0	500	500	0.20	0	0	0	60,100	24,900	85,000	85,000
Liquor	Windhoek	Ondangwa	601	249	850	0	300	300	0.20	0	0	0	36,100	14,900	51,000	51,000
Timber	Windhoek	Ondangwa	601	249	850	0	400	400	0.18	0	0	0	38,500	15,900	54,400	54,400
Hardware and electrical products	Windhoek	Ondangwa	601	249	850	0	300	300	0.18	0	0	0	32,500	13,400	45,900	45,900
Roofing sheets	Windhoek	Ondangwa	601	249	850	0	400	400	0.18	0	0	0	43,300	17,900	61,200	61,200
Machine and vehicle	Windhoek	Ondangwa	601	249	850	0	200	200	0.95	0	0	0	114,200	47,300	161,500	161,500
Mixed containerized freight	Walvisbay	Ondangwa	601	249	850	0	4,000	4,000	0.20	0	0	0	480,800	199,200	680,000	680,000
TOTALS						90,700	162,800	253,500		16,346,700	4,631,200	20,976,900	23,087,100	7,727,500	30,814,600	35,445,800

8.3 COMPARISON OF REVENUE AND OPERATING EXPENSES

In Section 7, the operating and maintenance expenses attributable to traffic using the Northern Railway Extension were discussed in some detail. These expenses were divided into two groups: those accruing on the existing route south of Tsumeb and those for the new line from Tsumeb to Ondangwa. These expenses are summarised in Table 8.5 along with the incremental revenue for Scenario 1 and 2 and the net income that results for the base year (Year 1 of the analysis).

TABLE 8.5
SUMMARY OF INCREMENTAL OPERATING EXPENSE
REVENUE AND NET INCOME
SCENARIO 1

SCENARIO	OPERATING EXPENSE (N$)	INCREMENTAL REVENUE (N$)	NET OPERATING INCOME (N$)
1	9,421,900	18,806,400	9,384,500
2	19,679,100	35,445,800	15,766,700

Scenario 1 generates a fairly substantial net income, but falls far short of covering repayment of capital costs at realistic interest rates, as will be shown in Section 8.4.

Scenario 2, produces a much higher net return and would cover expenses and provide enough surplus income to offset much of the capital expenditures required, although funding would have to be secured at a low interest rate.

To determine the results of extending the line from Ondangwa to Oshakati (Phase 2) and Ondangwa to Oshikango (Phase 3), the additional revenue that would accrue was compared to the increased operating costs. The comparison is given in Table 8.6

TABLE 8.6
COMPARISON OF INCREMENTAL OPERATING EXPENSE, REVENUE
AND NET INCOME
PHASES 2 AND 3

LINE SEGMENT	OPERATING EXPENSE (N$)	INCREMENTAL REVENUE (N$)	NET OPERATING INCOME (N$)
Ondangwa - Oshakati	606,600	445,800	(160,800)
Ondangwa - Oshikango	793,400	209,700	(583,700)
Both	1,268,400	655,500	(612,900)

As can be seen, neither line segment generates enough revenue to cover operating expenses. Until some source of substantial traffic is developed at Oshakati or Oshikango, the lines cannot be justified on a commercial basis. There may, however, be social considerations for constructing one or both lines that would outweigh purely financial considerations.

The Oshikango line would also be required if a connection into Angola to CFM is eventually built.

8.4 FINANCIAL EVALUATION

8.4.1 Introduction

The purpose of a financial evaluation is to determine, whether or not a project will meet the profit objectives expected by the investor. The evaluation measures the flow of funds generated by the project compared to capital and operating cost outlays over a specified period of time.

There are three common measurements used to assess the financial feasibility of a proposal. These are Internal Rate of Return (IRR), Net Present Value (NPV) and Benefit Cost Ratio. These have been calculated for the two traffic and revenue scenarios based on the following assumptions:

- The construction period for the line will be three years with approximately 10% of the capital costs expended in year 1, 50% in year 2 and 40% in year 3
- The project will be evaluated over 20 years, including the construction period
- The discount rate used is 10%
- At the end of 20 years, the residual value is estimated at 43% of the capital costs (see Appendix 8.2)
- Revenue during the first year of operation (year 4) will be 50% and operating expense 70% of the initial estimate, because traffic build-up will take some time
- Traffic and revenue are forecast to increase 3% annually
- Increases in operating costs have been calculated to accommodate the greater traffic. Details are shown in Appendix 8.3.
- This analysis is conducted in constant rather than current terms. In such an analysis, the inflationary effects are removed. Thus the annual operating costs, incremental revenue and capital costs are in terms of today's money, not inflated future money.

8.4.2 Financial Analysis

The two key financial indicators for this analysis are the Net Present Value (NPV) and the Internal Rate of Return (IRR).

The NPV accounts for the time value of money and is the discounted value of the cash flows over the 20 year project life. The mark of a good investment is when the NPV is positive because, in that case, the present value of the revenues is greater that the present value of the costs.

The IRR is the rate of return at which the present value of the revenues equals the present value of the costs, i.e. the rate at which the NPV equals zero. An IRR greater than the target discount rate (in this case 10%) indicates a "good" project.

The Benefit Cost Ratio is the ratio of the sum of all discounted cash income to the sum of all discounted cash expenditures over the evaluation period of a project. Any result over 1.00 indicates the project will pay for itself and the higher the number, the better the results are. Typically, the Benefit Cost Ratio is used to compare different projects to get a quick evaluation of the relative financial merits.

The NPV and IRR for Scenarios 1 and 2 have been calculated and the results are shown in Table 8.7. Spreadsheets detailing all analyses are included in Appendix 8.4.

TABLE 8.7
FINANCIAL EVALUATION
INTERNAL RATE OF RETURN, NET PRESENT VALUE AND BENEFIT COST RATIO
SCENARIO 1 AND 2

SCENARIO 1				
Year	Revenue (N$)	Operating Expense (N$)	Capital Costs (N$)	Residual value (N$)
1			-21,273,500	
2			-135,143,300	
3			-125,362,000	
4	10,275,100	-6,959,800		
5	21,166,800	-9,579,400		
6-19	Increases Each year	Increases Each Year		
20	32,927,200	-11,887,100		119,967,300
INTERNAL RATE OF RETURN				**2%**
NET PRESENT VALUE				**-126,551,600**
BENEFIT COST RATIO				**0.62**

SCENARIO 2				
Year	Revenue (N$)	Operating Expense (N$)	Capital Costs (N$)	Residual value (N$)
1			-21,273,500	
2			-135,143,300	
3			-130,062,000	
4	19,366,300	-14,310,900		
5	39,894,600	-20,171,900		
6-19	Increases Each year	Increases Each Year		
20	62,154,300	-25,182,900		123,409,600
INTERNAL RATE OF RETURN				**6%**
NET PRESENT VALUE				**-72,574,900**
BENEFIT COST RATIO				**0.89**

Both Scenarios 1 and 2 have an IRR of less than the 10% discount rate and, consequently negative NPV's.

The 2% IRR of Scenario 1 indicates that the project is not financially feasible under the pricing and service assumptions discussed earlier.

Scenario 2 has an IRR of 6% and a NPV of - N$ 72,6 million. Therefore, the project under the Scenario 2 pricing and service assumptions is marginally feasible. The IRR still fails to meet the discount rate, but the results are much better than Scenario 1.

The key difference in the two scenarios is in the service and pricing assumptions. If this project is implemented under basically the status quo pricing and service, then it is unlikely to be a financial success. However, if the pricing and service recommendations for Scenario 2 are adopted, then the project is feasible, although only if low interest rate financing is obtained.

8.4.3 Variations of Revenue and Cost Estimates

To determine how the financial results would be affected by changes in the cost and revenue estimates used, six modifications were made in the forecast for Scenario 2:

Case 1: Revenue 20% higher than forecast

Case 2: Revenue 20% lower than forecast

Case 3: Construction costs 25% greater than forecast

Case 4: Traffic build-up takes 5 years rather than 2

Case 5: Operating expense 20% higher than forecast

Case 6: Operating expense 20% lower than forecast

The results of these changes in the financial indicators are shown in Table 8.8.

TABLE 8.8
FINANCIAL RESULTS WITH DIFFERING REVENUE AND COST ESTIMATES
SCENARIO 2

	MODIFICATION	SCENARIO 1		
		IRR	NPV (N$)	BC RATIO
1	Revenue 20% higher than forecast	9%	-19,264,300	1.06
2	Revenue 20% lower than forecast	3%	-125,883,500	0.71
3	Construction cost 25% higher than estimated	4%	-125,323,900	0.78
4	Traffic takes 5 years to build up to maximum	5%	-93,071,200	0.82
5	Operating expense 20% higher than forecast	4%	-98,320,100	0.82
6	Operating expense 20% lower than forecast	7%	-46,830,500	0.97

As would be expected, if revenue is 20% higher than forecast, financial results are considerably improved and the IRR increases to 9%. With revenue 20% below that forecast, the IRR falls to 3%.

Construction costs 25% over the estimate, traffic build up taking 5 years rather than the 2 forecast and operating expenses 20% higher than the estimate used, lower the IRR to 4-5%.

And finally, if operating expense is 20% lower than forecast, the IRR increases to 7%.

The important points to note are:

- Even with revenue considerably below (20%) that forecast, the proposed railway will cover expenses
- Construction costs above (25%) those estimated only lower the IRR from 6% to 4%
- Much slower traffic build-up only lowers the IRR to 5%
- Operating expenses 20% higher than estimated lowers the IRR 2 points to 4%.

The main conclusion to be drawn is that even with much more pessimistic results - lower revenues, higher constructions costs, greater operating expenses and slower build-up of traffic - the proposed railway extension would, at a minimum, cover operating expenses and be marginally feasible on a financial basis.

On the favourable side, if traffic and revenue exceeds forecasts or operating expenses are lower than estimated - or some combination of both - the project could approach a 10% IRR.

8.5 ECONOMIC EVALUATION

8.5.1 Introduction

Unlike the financial evaluation that simply considers the in- and outflows of funds to the owner of a railway, the economic evaluation also considers the impact of the new rail line on the region and nation, at large. Instead of simply comparing the revenues accruing to the railway, the economic evaluation considers the overall savings in resources resulting from the diversion of traffic from roads to railway, which are offset against the costs.

The operating and capital costs used for the economic appraisal differ from those used for the financial evaluation in that they are adjusted to delete taxes, which are a transfer charge and do not represent a consumption of resources. Also societal benefits are taken into consideration.

A major factor in which the economic appraisal differs from the financial, is that the savings resulting from movement of traffic by rail, rather than road, is taken into account to recognise the savings in road maintenance.

8.5.2 Economic Analysis

The economic analysis compared the total costs of movement by road in economic terms, with the movement by rail. The costs considered include the construction of additional infrastructure and rolling stock and the increased operating expense.

Reduced heavy truck traffic will decrease road maintenance expense and produce measurable savings.

The economic benefit for transport of goods by rail rather than road has been computed on the basis of the cost calculated in the on-going RUC process at N$0.72 per truck-km.[4]

An additional factor is that the diversion of freight traffic and heavy trucks from road to rail will not only reduce road maintenance, but will improve safety in that accidents will decrease and journey times for vehicles will be shortened. Savings from reduced delays and less accidents have not been quantified as there is insufficient information available to make the necessary calculations.

[4] Report on workshop on Options for Weight-Distance Charges for Diesel Vehicles, 27 October 1998.

The factors used to convert financial to economic terms are shown in Table 8.9. These are based on the experience of the Department of Transport and the Consultant's judgment, and are believed to be appropriate for the situation under consideration.

TABLE 8.9
FACTORS USED FOR CONVERSION FROM FINANCIAL TO ECONOMIC COSTS

COST ITEM	FACTORS
Property Acquisition	1.00
Infrastructure, except Unskilled Labour	0.73
Unskilled Labour	0.10
Rolling Stock and Other Equipment	0.80
Operating Costs	0.85
Maintenance Costs	0.85
Payments to Third Parties	0.85

Table 8.10 shows a summary of the capital costs of the Phase 1 line from Tsumeb to Ondangwa in economic terms.

TABLE 8.10
SUMMARY OF CAPITAL COSTS IN ECONOMIC TERMS

COST CATEGORY	FINANCIAL COSTS (N$)	ECONOMIC COSTS (N$)
Land Acquisition	5,180,000	5,180,000
Infrastructure	274,650,300	200,429,000
Rolling Stock and Other	8,510,000	5,292,800
TOTALS	**288,340,300**	**210,901,800**

Further adjustments made to convert the financial figures to economic terms are shown in Table 8.11. The benefits from reduced heavy truck operation were derived by estimating the truck-km that would be eliminated in traffic moved by rail rather than truck. Details of the calculations are shown in Appendix 8.5.

TABLE 8.11
PHASE 1
CHANGES IN OPERATING EXPENSES TO CONVERT FINANCIAL TO ECONOMIC TERMS

CATEGORY	ANNUAL EXPENSE			
	EXPRESSED IN FINANCIAL TERMS		EXPRESSED IN ECONOMIC TERMS	
	SCENARIO 1 (N$)	SCENARIO 2 (N$)	SCENARIO 1 (N$)	SCENARIO 2 (N$)
Railway Operating and Maintenance Expense	9,421,900	19,679,100	8,008,600	16,727,200
Benefits from Reduced Heavy Truck Operation	0	0	(1 775,600)	(3,297,500)

Table 8.12 displays the IRR and NPV of the project in economic terms for both scenarios. As can be seen, the resulting IRR for Scenario 1 is 6% with a NPV of - N$50.9 million. It must be concluded that, even on an economic basis, Scenario 1 fails to meet reasonable standards of feasibility.

Scenario 2, on the other hand, has a 12% IRR and an NPV of N$ 26,2 million which are respectable results, especially for a project that has wide reaching societal benefits for the region and the nation, as a whole.

TABLE 8.12
ECONOMIC EVALUATION
INTERNAL RATE OF RETURN, NET PRESENT VALUE AND BENEFIT COST RATIO
SCENARIO 1 AND 2

SCENARIO 1				
Year	Revenue (N$)	Operating Expense (N$)	Capital Costs (N$)	Residual value (N$)
1			-15,859,300	
2			-96,077,100	
3			-97,437,300	
4	10,275,100	-5,915,800		
5	21,166,800	-8,142,500		
6-19	Increases Each year	Increases Each Year		
20	32,927,200	-10,104,000		89,612,000
INTERNAL RATE OF RETURN				**6%**
NET PRESENT VALUE				**-50,947,600**
BENEFIT COST RATIO				**0.86**

SCENARIO 2				
Year	Revenue (N$)	Operating Expense (N$)	Capital Costs (N$)	Residual value (N$)
1			-15,859,300	
2			-96,077,100	
3			-98,965,300	
4	19,366,300	-12,164,300		
5	39,894,600	-17,146,100		
6-19		Increases Each Year		
20	60,344,000	-21,770,300		90,265,900
INTERNAL RATE OF RETURN				**12%**
NET PRESENT VALUE				**26,197,000**
BENEFIT COST RATIO				**1.26**

The same variations that were made in the financial case, were made on an economic basis and the results are shown in Table 8.13.

TABLE 8.13
ECONOMIC RESULTS WITH DIFFERING REVENUE AND COST ESTIMATES
SCENARIO 2

	MODIFICATION	IRR	NPV (N$)	BC RATIO
1	Revenue 20% higher than forecast	15%	75,507,200	1.51
2	Revenue 20% lower than forecast	8%	-27,112,000	1.01
3	Construction cost 25% higher than estimated	9%	-15,849,900	1.09
4	Traffic takes 5 years to build up to maximum	8%	-28,599,600	1.00
5	Operating expense 20% higher than forecast	10%	4,314,000	1.14
6	Operating expense 20% lower than forecast	13%	48,079,300	1.40

As with the financial case, even pessimistic changes - lower revenue or higher expenses - do not result in returns that fail to cover costs. Revenue 20% higher than forecast raises the IRR to 15% and revenue 20% lower only decreases it to 8%. Capital costs 25% over the estimate and traffic build-up taking 5 years only results in the IRR decreasing to 9% and 8%, respectively. Operating expenses 20% higher than estimated lower the return 2 points to 10% and, as would be expected, 20% lower operating costs raise the return to 13%.

8.6 CONCLUSIONS

The Northern Railway Extension would at least generate enough revenue to cover expenses and even if traffic is less than forecast or construction or operating costs significantly over those estimated, the line would not operate at a loss, even under the lower traffic forecasts of Scenario 1.

On a financial basis the new route would not, except with major traffic growth and extremely efficient operations provide returns that would make the project viable as a commercial venture, unless low interest financing can be obtained.

Economic returns are much better than financial, but Scenario 1 does not appear to be a viable option.

Scenario 2, on the other hand, has an economic 12% IRR and an NPV of N$262.0 million which are respectable results, especially for a project that has such wide reaching societal benefits for the region and the nation, as a whole.

In summary, the Northern Railway Extension would cover operating costs and provide some surplus to amortise the investment needed. However, the project cannot be entirely financed on a commercial basis and construction will require assistance by Government or foreign lending or donor agencies.

9. IMPLEMENTATION, PHASING AND FINANCIAL PLAN

9.1 CONSTRUCTION PHASING AND SCHEDULES

Although the Northern Railway Extension could be built as a single project with nearly simultaneous opening of the entire line from Tsumeb to Ondangwa, Oshakati and Oshikango, because of traffic and cost considerations it is recommended that construction be done in three phases.

Phase 1 (248 km) from Tsumeb to Ondangwa will be constructed first and Phases 2 and 3 extending the line to Oshakati (40 km) and Oshikango (62 km) would be built later.

The extension to Oshakati should be constructed when a plant that generates substantial traffic is established.

Whether and when the line to Oshikango would be built, will likely be determined by one of two possible occurrences: greatly increased cross-border traffic with Angola or (as has been considered) an extension of CFM southward from Cassinga that would facilitate a rail connection between the two countries.

It would be advisable that the Government quickly take the necessary action to secure options for eventual acquisition of the property needed to construct the extensions to Oshakati and Oshikango and station sites in these towns, even though construction of the rail lines may not take place for years.

Figure 9.1 depicts a proposed construction sequence and schedule for Phase 1. No actual dates are shown, as this will be dependent on Government approval and the securing of financing.

As indicated, following Government approval, the line could be built and in service within 36 months. The first activities would be making a detailed survey and an environmental assessment, finalizing the alignment, doing detailed design and starting the property acquisition process. Also, the necessary equipment and facilities to manufacture concrete sleepers and weld rail would need to be arranged for, either with contractors or internally by NamRail.

An important step that must be accomplished early is locating a source and purchasing suitable relayer 48kg/m rail. The use of new rail is not warranted considering the tonnage and axle loads the line will handle and would increase the total construction cost considerably.

The recommended route alignment, construction phasing and station locations are shown in Figure 9.2.

9.2 CONSTRUCTION PROGRAMME

Most of the construction material required for the project will be transported via Tsumeb to the north. The existing railway line ends at Tsumeb and in order to minimize truck haulage, it is proposed that construction of the railway be started at Tsumeb and that the completed sections of the railway be used to transport material to the construction activities.

It is estimated that the actual construction time for Phase 1 will be 30 months. An additional 6 months, following approval by the Government will be needed for mobilisation.

Extra time has been included in certain categories of work (mainly earthwork, structures and track construction) to allow for possible shut downs during the rainy season.

FIGURE 9.1

PHASE 1

IMPLEMENTATION SCHEDULE

ACTIVITY	DURATION MONTHS	YEAR 1	YEAR 2	YEAR 3
Approval by GRN and Securement of Funding				
Survey, EA and Design	12			
Tender Preparation and Rev	12			
Project Management	36			
Contractor's Establishment	8			
Property Acquisition	22			
Locate and Purchase Rail	10			
Set up Sleeper and Culvert Casting and Rail Welding Facility	10			
Manufacture Sleepers and Culverts and Weld Rail	28			
Cleaning and Grubbing	22			
Earthwork	22			
Track Construction	24			
Build Structures	22			
Construct Stations and other Facilities	24			
Build Roads, Fences and Crossings	30			
Install Communications Equipment	8			
Build/aquire Rolling Stock	24			
Start Operations				

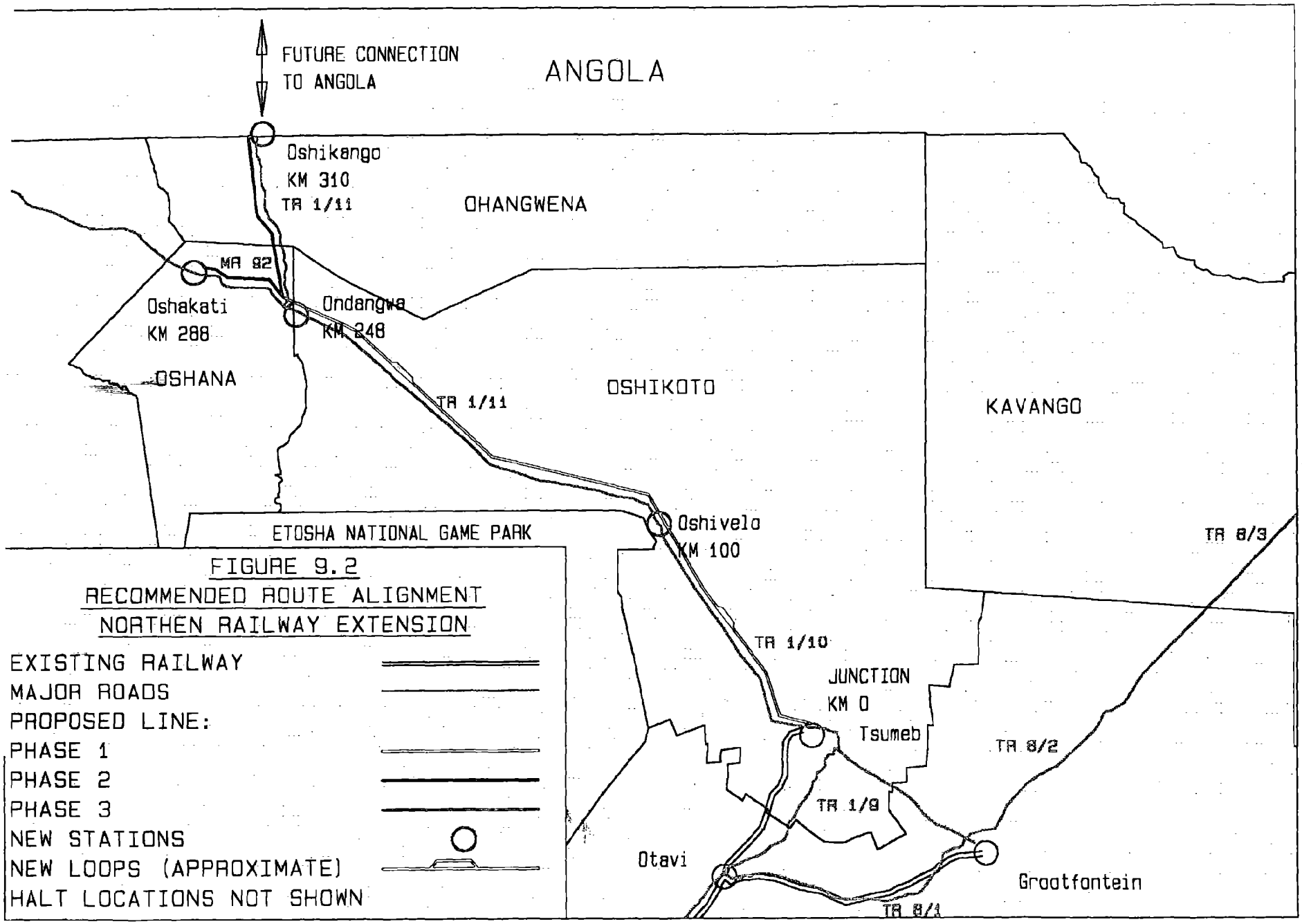

FIGURE 9.2

RECOMMENDED ROUTE ALIGNMENT

NORTHEN RAILWAY EXTENSION

EXISTING RAILWAY

MAJOR ROADS

PROPOSED LINE:

PHASE 1

PHASE 2

PHASE 3

NEW STATIONS

NEW LOOPS (APPROXIMATE)

HALT LOCATIONS NOT SHOWN

The actual laying of track will take 24 months and the preceding 12 months are required for:

- Design, tender and planning
- Ordering and receipt of rail
- Setting up rail welding plant
- Establishing local plants in Tsumeb and starting the manufacturing of sleepers and culverts
- Establishing a crusher for ballast stone and beginning production
- Opening borrow pits and starting with the construction of the roadbed formation
- Starting with the construction of the river bridge at Omuramba Owambo and proceeding with two road over rail bridges between Tsumeb and Ondangwa

It is estimated that the construction period for Phases 2 and 3, if these are built, would be:

- Phase 2 9 months
- Phase 3 7 months

To the extent possible, NamRail technicians and other personnel should be assigned to this project and hiring of new, skilled workers kept to an absolute minimum.

Casting of preformed culverts and other drainage structures should be done by contractors utilising local unskilled workers.

Track laying procedures have been planned to be performed to the extent possible with labour based methods. To minimize construction costs, it is proposed that NamRail supply the tamper and ballast regulator required. Outside engineering personnel could supplement NamRail staff, when necessary.

Concrete sleeper manufacturing and rail welding would be done on-site at Tsumeb. The necessary equipment could be purchased, leased for the duration of the project or performed by outside contractors. These arrangements all have both advantages and disadvantages and would have to be carefully evaluated before final decisions are made.

9.3 PROCUREMENT ISSUES

With respect to material and equipment procurement, it is intended that as much as possible be obtained and/or manufactured within Namibia.

Rail, however, must be obtained on the international market and following sleepers, is the most costly material needed. Procurement of rail of the required quality at the lowest possible cost will have a major impact on the overall cost of the project.

Sleepers will be manufactured locally and pose no particular problems. Suitable ballast stone is available from three sources (Keetmanshoop, Tsumeb and Ruacana) and the source to be utilized will be dependent on delivered price.

The additions to the rolling stock fleet – containers and wagons - can be converted and built by NamRail personnel at the Windhoek workshop. This will assist NamRail in maximising the use of a presently under utilised workshop.

9.4 CONTRACT DOCUMENTS

Although a large component of the project can be done by NamRail, it is still recommended that a complete set of contract documents be prepared for the following reasons:

- To provide construction managers with a better overview of the total contract.
- Schedules of quantities in the document may be used to compile a construction programme and plan the execution of the work.
- A quality assurance system can be implemented at the hand of the document.
- The document may serve as the basis for appointing subcontractors who will do a substantial part of the work.

It is proposed that the FIDIC General Conditions of Contract and the South African Bureau of Standards Standardized Specification for Civil Engineering Construction, be used. Section DN "Earthworks (Railway Sidings)" and Section NB "Railway Sidings (Trackwork)" in the SABS 1200 Specification, specifically apply to the construction of a rail line.

It is also proposed that tender documents clearly spell out the requirements for maximum use of labour based construction methods. Appendix 9.1 suggest tender wording.

9.5 FINANCING OPTIONS AND POTENTIAL FUNDING

Financing for the Northern Railway Extension could potentially come from five sources:

- Private sector funding
- Some concessionairy arrangement whereby a private corporation would build and operate the line with or without eventual transfer of ownership back to the Government and NamRail.
- Government funding
- International lending agencies
- Foreign government donors

Also, some combination of funding from two or more of these sources is possible and, in fact, likely to be the funding option eventually selected.

The obvious international lending sources – International Monetary Fund (IMF), World Bank and African Development Bank (ADB) should be contacted to determine what funding might be available.

Contact has already been made with a representative of the ADB and this organisation will review the rail extension project. The ADB works closely with the IMF and World Bank and could assist in obtaining financial support from these organisations.

Discussions have also taken place between Government officials and representatives of several foreign governments that might provide low interest loans or grants. These efforts should, of course, be continued.

- Financial participants

Aside from the Government, international lending agencies and donor nations, there are at least two other organisations that could participate in funding the line extension:

- NamRail
- Industrial customers

NamRail will obviously benefit if the extension is built and should to some extent pay part of the cost. At a minimum, NamRail could pay the cost of the rolling stock and containers required, provide transportation of construction material free or at reduced rates, provide track laying equipment and furnish supervisors and skilled workers. Although NamRail's present financial condition may require that the Government advance funds for some or all of these activities, it should be strictly on a loan basis to be repaid when the new line is operational and income starts to be generated.

Industrial customers will benefit from lower transportation costs and should participate to the extent of paying for any private sidings needed. Also, the petroleum companies might be induced to provide the expanded fuel depot that will be needed at Ondangwa.[1] This could be done on a rebate basis; the industry would build the facility and NamRail would pay the cost back over time by moving fuel at reduced rates, until the pay back period is complete.

Given the low financial returns the project will produce, it is very doubtful that private financing could be obtained to fund the entire project.

With respect to a concessionary arrangement, a pre-requisite normally is that the concessionaire receives something of value for the risk assumed – property or development rights, for example. In this case, there are no immediately obvious commercial inducements that could be granted to attract a concessionaire.

When considering the possibility of some sort of concessionary arrangement, one fact must be kept in mind: To achieve the operating expense benefits that have been estimated, the line extension must be operated as an integral part of the entire NamRail system. As a totally independent unit, the extension cannot be a viable financial operation.

This limits the activities in which the concessionaire might be involved to financing, construction, marketing efforts and, perhaps, on-line development of commercial and industrial enterprises that would use rail service.

Another possible option for a concessionaire might be to operate the container terminal at Ondangwa and handle delivery services.

Even if a concessionaire participates and NamRail and private industries contribute to the project, it is clear that the Government must fund, with or without international backing, most of the line extension.

Whether or not the Government would fund the project and over what time period and under what conditions will be a policy decision and based on the availability of money and how the railway extension ranks in priority compared to other public projects.

[1] The cost of the depot is estimated at N$ 1.2 million and is included in the capital costs.

Calculations were made to determine the Government contribution for capital costs that would be necessary to make the project financially attractive to a concessionaire or commercial lending agency. The results are shown in Table 9.1 for Government participation levels of 30% and 50% of total capital costs.

TABLE 9.1
FINANCIAL RESULTS WITH VARIOUS
LEVELS OF GOVERNMENT CONTRIBUTION

GOVERNMENT PARTICIPATION		RESULTS TO A PRIVATE INVESTOR		
%	AMOUNT (N$)	IRR (%)	NPV (N$)	BC RATIO
30	85,943,600	9	-8,649,100	1.61
50	143,239,400	13	32,566,700	3.50
55	157,563,300	15	44,127,500	3.90

Although attracting a concessionaire may be difficult with the restrictive conditions that will apply (primarily that NamRail must be the operator) tenders should be requested. Prior to the request for tenders being circulated, however, the Government must determine what its financial contribution will be.

10. CONCLUSIONS AND RECOMMENDATIONS

10.1 INTRODUCTION

The proposed railway between Tsumeb and Ondangwa, or the entire extension including the lines to Oshakati and Oshikango would be a significant expansion of the NamRail network. The Northern Railway Extension will not only provide a new transportation mode for the Four O Regions, but will tie the area economically and socially closer to Windhoek and the rest of Namibia.

This concluding section of the report summarises the main findings of the feasibility study relative to its constructability, traffic and revenue potential, operating feasibility and expenses, effects on the existing NamRail system and financial and economic viability.

10.2 KEY FINDINGS

10.2.1 Constructability

The proposed railway from Tsumeb to Ondangwa, Oshakati and Oshikango would be a relatively simple construction project. The line would have no long bridges, would be mostly tangent with no sharp curves, have no significant grades and would require no innovative or expensive construction techniques.

Property acquisitions necessary would not require the taking of any sensitive areas: national parks, religious or educational sites, for example.

While property acquisition would need to be handled fairly and sensitively in both communal and commercial land areas, it should not be a particularly difficult process.

10.2.2 Traffic and Revenue Potential

The traffic and revenue potential of the proposed line has been assessed by identifying the present freight and passenger flows in the route corridor and forecasting the extent to which the traffic is likely to switch to rail.

The approach used is conservative as it only forecasts 3% annual traffic and revenue growth, compared with the predicted area population growth of 6%. Specific developments that are nearly certain to happen (a new beer bottling plant in Oshakati for example) have also been considered.

As discussed in Section 2 the amount of freight traffic captured by rail will be influenced greatly by how effective NamRail is in addressing the performance objectives of customers and how aggressive it is in pricing service competitively.

The major traffic sources would be fuel, cement, aggregates, bricks, sugar and containerised freight. The goods carried in containers would be mainly bottles and packaging, maize meal, bulk and packaged beer, other beverages and furniture.

Based on the freight traffic analysis made, the summary of traffic that will be diverted to rail under the Scenario 1 and Scenario 2 service and marketing assumptions is as shown in Table 10.1.

TABLE 10.1
FORECAST FREIGHT TRAFFIC

SCENARIO	TOTAL TONS
Scenario 1	135,500
Scenario 2	253,500

The incremental revenue, and average revenue per ton, that NamRail would receive for handling the traffic forecast is shown in Table 10.2.

TABLE 10.2
FORECAST FREIGHT REVENUE

SCENARIO	TOTAL REVENUE (N$)	AVERAGE REVENUE (N$/ton-km)
Scenario 1	18,806,400	0.22
Scenario 2	35,445,800	0.19

As discussed in Section 2, passenger traffic will not generate significant revenue and would at best, be a breakeven proposition. Therefore, no detailed calculations of passenger revenue were made.

10.2.3 Operating Feasibility

From an operational standpoint, the new route either to Ondangwa or extended to Oshakati and/or Oshikango would be a relatively simple operation. In the foreseeable future, only one train in each direction, six days weekly, would accommodate the traffic. The proposed freight and passenger service would complement and extend the service that now terminates at Tsumeb.

The Northern Railway Extension would be relatively inexpensive to operate and maintain because of the easy terrain in which it would be located.

The line extension must be operated as an integral part of the entire NamRail system to provide the low incremental costs estimated.

10.2.4 Effects on the Existing Railway

Part of the study included examination of the effects the line would have on NamRail facilities and operations south of Tsumeb. For the most part, these effects would be minor: a second locomotive on some trains, a limited number of additional trains on some lines and, obviously more tonnage and wagons transported.

Aside from the addition of a small number of wagons and containers as noted in Section 3, the facilities and rolling stock now in service should accommodate the forecast traffic increases. Also, no additions to staff will be needed at any location south of Tsumeb.

The added traffic on existing lines should not cause any noticeable increase in permanent way maintenance costs.

10.2.5 Financial and Economic Viability

For the foreseeable future the line would not handle enough traffic or generate sufficient revenue to be a commercially viable project. It would, however, even with less traffic than forecast and higher construction costs or operating expenses at least cover all expenses with a surplus to amortise part of the capital costs.

On the positive side there are three possible developments that could cause a major increase in traffic and revenue and significantly increase the line's rate of return. These potential developments are:

- Major population growth, currently estimated at 6% annually, in the area increasing demand for consumer products.
- Increased commercial activity creating more transport of materials and products.
- Stabilisation of the political situation in Angola resulting in increased traffic flows.
- A connection between NamRail and CFM

None of these events is a certainty, but they all are reasonable expectations.

10.2.6 Environmental Impacts

No serious impacts to the natural environment that could not be adequately mitigated were noted. Negative social impacts identified were largely related to relocation, land taking and suitable compensation and these issues can be fairly resolved. By a large margin, positive social effects outweigh negative impacts.

10.2.7 Socio Economic Benefits

The proposed railway extension has the support of the people in the Region and will produce a number of significant socio economic benefits, including:

- Help integrate the region into the mainstream of Namibia both socially and commercially
- Reduce truck traffic and lower maintenance costs for roads
- Improve road safety by reducing traffic
- Provide competition to trucks that will help hold down transportation costs
- Make available a low cost form of transportation for many commodities
- Provide a safe and low cost form of transportation for passengers
- Improve the possibility of commercial development in the region
- Enhance trade with Angola

- Increase the use of Walvis Bay for cargo (mostly containerised) destined for Angola by allowing rail movement to the border at costs lower than truck
- Provide over 700 construction jobs for the 30 month construction period
- Provide about 25 – 30 new permanent staff positions on the railway
- Help create jobs in commercial enterprises that would not have located in the region if the railway did not exist

Although these are general and for the most part non-quantifiable, they are important results and should be considered, along with financial and economic measurements when evaluating the worth of the project.

10.2.8 Positive Effects on the Existing NamRail System

The Northern Railway Extension would provide at least five significant long term benefits to NamRail:

- Lengthen hauls to the north and increase revenues
- Broaden the traffic base, contribute to fixed costs and lower system unit costs
- Make greater and more efficient use of now under-utilised assets: infrastructure, rolling stock and staff
- Help prevent almost certain staff reductions in the future if NamRail cannot reduce operating costs and effectively compete with road transport
- Create a line that could be the first link in an eventual rail route to connect with the Angolan railway system (CFM)

10.2.9 Development Policies

The Northern Railway Extension conforms with and supports Government's developmental policies and programs for the Four O Regions in particular and Namibia in general.

While NamRail and rail shippers will gain financially from the new line, most benefits will accrue to the people in the region and to the Nation, as a whole. During construction, a large number of jobs will be created and after the line is in operation, commercial and industrial growth will occur, which would not have been possible without the railway. The Government will benefit financially by increased tax revenues from the expanded commercial and industrial activity will assist a large population group to become more self sufficient and require less social welfare outlays.

10.3 CONCLUSIONS

The construction and operation of the proposed Northern Railway Extension is technically feasible and would form a useful addition to the transport infrastructure of the Four O Regions. However, the traffic density in the route corridor is light and at least over the short term, the revenues and financial returns generated would be limited.

The economic benefits would, however, be immediate and far reaching creating employment both during the construction period and after as commercial development occurs.

One very important factor that should be considered is that the development of the Four O Regions has reached a stage where the whole development philosophy is changing from a basic commerce and trade orientation to industrial development.[1] This will inevitably result in heavier traffic of raw materials, finished products and passengers, all of which must be transported by road if the rail line is not built. Increased road traffic, more accidents and higher maintenance costs will be the end result. The movement of goods and people by rail can, to a large extent, prevent these problems.

While it is forecast that the new line at least as far as Ondangwa, would be able to earn sufficient revenue to cover operating expenses and provide some surplus, the surplus would be insufficient to offset the entire capital cost of the project if financed at commercial rates.

Therefore, the new line could not be financed on a commercial basis and it is extremely unlikely any build-operate-transfer scheme could be developed that would attract a concessionaire without a major Government investment or involvement by some international lending agency or donor.

10.4 RECOMMENDATIONS

The extension will generate enough revenue to cover operating costs and partially amortise the capital costs. The economic returns will be quite good and considering the wide reaching social benefits, the line should be built.

All possible sources of funding should be explored, including participation by Government, international lending agencies and foreign donors.

At this time, only Phase 1 between Tsumeb and Ondangwa should be considered as there will be insufficient traffic and revenue to even cover operating costs for Phases 2 and 3 to Oshakati and Ondangwa.

Tenders should be requested from concessionaires to at least partially finance, build and possibly participate in the operation of the extension. Government financial assistance will undoubtedly be needed and tenderers advised in advance the amount likely to be available.

Participation in capital costs on a private basis by NamRail and major industrial customers should be explored.

The socio economic development of the Four O Regions and further industrialisation would be greatly enhanced by a railway. The cost benefits to the national economy also weigh in favour of the new line.

The Northern Railway Extension would be financially, economically and socially beneficial to the Four O Regions, Namibia as a whole and NamRail. Whether or not it can be built in the near future will depend on locating a source of capital funding.

[1] A recently established paint manufacturing factory in Oshakati and a steel manufacturing facility in Ondangwa, as well as furniture making are some examples.